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EG&G INC.

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DOMINIC - TANANA

FIRE BALL YIELD PHOTOGRAPHY
AND CALCULATIONS
PRELIMINARY REPORT

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AND CALCULATIONS

PRELIMINARY REPORT

EG&G Report No. B-2389

30 July 1962

Approved by:

D. J. Barnes

UNCLASSIFIED

EDGERTON, GERMESHAUSEN & GRIER, INC.
Boston, Massachusetts Las Vegas, Nevada
Santa Barbara, California

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ABSTRACT

This report contains a summary of EG&G fireball photography and a preliminary analysis of the results for Shot Tanana of Operation Dominic. Tanana, an LRL-sponsored device, was detonated on 25 May 1962, at GZ-10, southwest of Christmas Island. Measured time of drogue-retarded fall from the B-52 delivery aircraft, flying at an altitude of 25,000 feet, was 50.853 seconds. The device was detonated at an altitude of 9,030 ft ± 50 ft above MSL. The local Christmas Island time of detonation was 0708:50.7922, uncorrected for WWVH propagation time.

Phi scaling indicates a fireball yield of 2.3 kt ± 0.3 kt, and Mach scaling shows a yield of 2.4 kt ± 0.4 kt.

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1.0 BHANGMETER OPERATION AND DATA

Nine Bhangmeters were employed on Shot Tanana: three at the EG&G Timing Trailer at A Site, two each on the two C-130 aircraft, and two on the B-52 delivery aircraft. All Bhangmeters except the RO-1 No. 3 (40 msec full scale) were set at 80 msec full scale to accommodate the time-to-minimum of the expected yield. Minimum time therefore occurred between the second and third pip on those traces, making the time resolution of the readings poor. The results, however, do not contradict the yield obtained by other methods. Table 1 summarizes Bhangmeter operation and the data obtained.

Table 1. Bhangmeter data.

Location	Type	Reading	
		No. of Pips	Time (msec)
Timing Trailer, A Site	RO-1 No. 1	2.75	5.5
Timing Trailer, A Site	RO-1 No. 2	2.5	5.0
Timing Trailer, A Site	RO-1 No. 3	5.75	5.75
Aircraft 298 (C-130)	MK-V, S/N 1	2.75	5.5
Aircraft 298 (C-130)	MK-V, S/N 2	3.0	6.00
Aircraft 299 (C-130)	MK-V, S/N 3	2.75	5.5
Aircraft 299 (C-130)	MK-VI, S/N 4	2.75	5.5
B-52 Aircraft	ASH 4	2.75	5.5
B-52 Aircraft	MK-VI	3.0	6.0

The average t_{min}, 5.58 msec, corresponds to a yield of 2.2 kt ± 0.3 kt at an ambient air density of 0.891 grams/liter for an altitude of 9,030 feet.

2.0 CAMERA INSTRUMENTATION AND OPERATION

Photographic coverage of fireball growth was provided by land-based camera installations at Sites A, MM, and D on Christmas Island and by airborne installations on two C-130 aircraft. The B-52 drop aircraft was also instrumented to record fireball formation. The exact instrumentation of these stations is detailed in Appendix A, and an evaluation of the operation of each camera is given on the Film Comment Sheet, Table 2. Complete survey data for the actual GZ-10 for Tanana are given in Appendix B.

2.1 Position of Burst

Six theodolite cameras were operated, two at each of the ground stations. All six theodolites operated properly. A photo-triangulation of the position of burst was performed on the basis of records from all three stations. A diagram showing the angular off-axis position of the burst from the A, MM, and D Site stations is presented in Fig. 1. The calculated position of burst was:

N 182590
E 690410 } referenced to H&N Universal Transverse Mercator Grid

Height 9,030 ft ± 50 ft above MSL

The resultant slant ranges from the camera stations are 53,829 feet from MM Site and 53,768 feet from A Site. These figures agree quite well with the Sandia Corporation radar slant-range measurements of 53,760 feet and 53,610 feet, respectively, from the MM and A Site radar positions located adjacent to the camera stations.

[redacted]

Table 2. Film comment sheet - Tanana.

Camera	Film No.	Speed (fr/sec)	Comments
			A SITE
DFX-12	106070	26,000 (nom.)	Fireball outside field of view; a small segment appears in frame at later times.
PS4B-1	106046	3,150	FB well-centered at zero time. Good record.
PS4B-2	106051	1,950	Fireball 1/10 in. below center of frame at zero time. Good record.
PS10B-1	106054	600	Fireball in center of frame at zero time. Good record.
M-46	106059	100	Well-centered image at zero time. Good record.
Wild 233	106066	-	Good record.
Wild 164	106089	-	Good record.
Rap 103	106085	57 usec	Fireball image. Poor focus.
Rap 101	106074	107 usec	Fireball image. Good record.
Rap 120	106075	233 usec	Fireball image. Good record.
Rap 118	106082	529 usec	Fireball image. Good record.
			MM SITE
DFX-13	106072		One quarter of fireball cut off by edge of frame. Good record.
PS4B-3	106053	3,050	Fireball low and to the right of frame center at zero time. Readable record.
PS4B-4	106048	2,400	Fireball just right of frame center at zero time. Good record.
PS10B-3	106056	600	Well-centered FB at zero time. Good record.
M-47	106061	100	Image just right of center at zero time. Good record.
Wild 148	106068	-	Good record.
Wild 147	106069	-	Good record.
Rap 107	106087	54 usec	Very poor focus. Poor fireball record.
Rap 105	106080	101 usec	Fireball image. Good record.
Rap 108	106081	246 usec	Fireball image. Good record.
Rap 114	106084	525 usec	Fireball image. Good record.

[redacted]

Table 2. Film comment sheet - Tanana (cont.).

Camera	Film No.	Speed (fr/sec)	Comments
			D SITE
DFX-11	106071		FB low and to the right of center. Good record.
PS4B-6	106047	2,250	FB right of center at zero time. Readable record.
PS4B-5	106052	3,200	FB right of center at zero time. Good record.
PS10B-2	106055	600	FB high and to the right of center. Good record.
M-43	106060	100	Image right of center. Good record.
Gal. 8904	106088	-	Good record.
Gal. 8903	106067	-	Good record.
Rap 117	106086	52.8 usec	Good record.
Rap 102	106077	95 usec	Good record.
Rap 113	106078	257 usec	Good record.
Rap 111	106083	494 usec	Excellent record.
			STATION 298 (C-130 AIRCRAFT)
PS4B-9	106049	2,400	Camera started late. Late FB at start of record.
WF8-2	106057	2,000 (nom.)	Camera started late. Late FB at start of record.
FD401-3	106064	1,500 (nom.)	Image right of center. Late fireball at start of record.
M-42	106062	75	Camera started late. Late fireball on first frame. Image well-centered.
			STATION 299 (C-130 AIRCRAFT)
PS4B-10	106050	2,250	Camera started late. Very late cloud at start of film.
WF8-3	106058	2,000 (nom.)	Camera started late. Late fireball record. No timing marks.
FD401-2	106065	1,500 (nom.)	Camera started late. Late fireball on first frame. Fireball near left-hand sprocket hole.
M-44	106063	100 (nom.)	Camera started late. Late fireball at start of record.

Table 2. Film comment sheet - Tanana (cont.).

Camera	Film No.	Speed (fr/sec)	Comments
		B-52 AIRCRAFT	
PS4B-8	106250	2,650	Fireball right of center. Good record.
WF4-6	106251	2,000 (nom.)	Did not operate.

2.2 Fireball Photography

Fireball growth was recorded and measured from all ground stations. All six high-speed Photo-Sonic cameras at these sites obtained usable fireball records.

The cameras in both C-130 aircraft started late, apparently because of failure to receive the ARM BARO signal and subsequent manual operation of the instrumentation system. The cameras at these stations recorded only late fireball pictures. The Photo-Sonic camera in the B-52 obtained a good fireball record, but the Fastax camera in that aircraft did not operate.

AFSWC furnished slant ranges as follows between the aircraft and the device: 31,700 feet ± 820 ft for the B-52 delivery aircraft, 65,094 feet ± 50 ft for Aircraft 299, and 63,031 feet ± 400 feet for Aircraft 298.

The aiming of all ground-based cameras was good. The radar-trained mount at A Site tracked well, the image being about one-half degree low in the frame, but centered horizontally. The MM Site mount was aimed about one degree high and one-half degree to the left of the fireball at zero time. The records from the fixed-mount camera station at D Site show the image to be well-centered vertically and one degree to the right of the frame center.

Good Dynafax records were obtained from D and MM Sites, although on the MM Site record, the image was located at the bottom edge of the frame,

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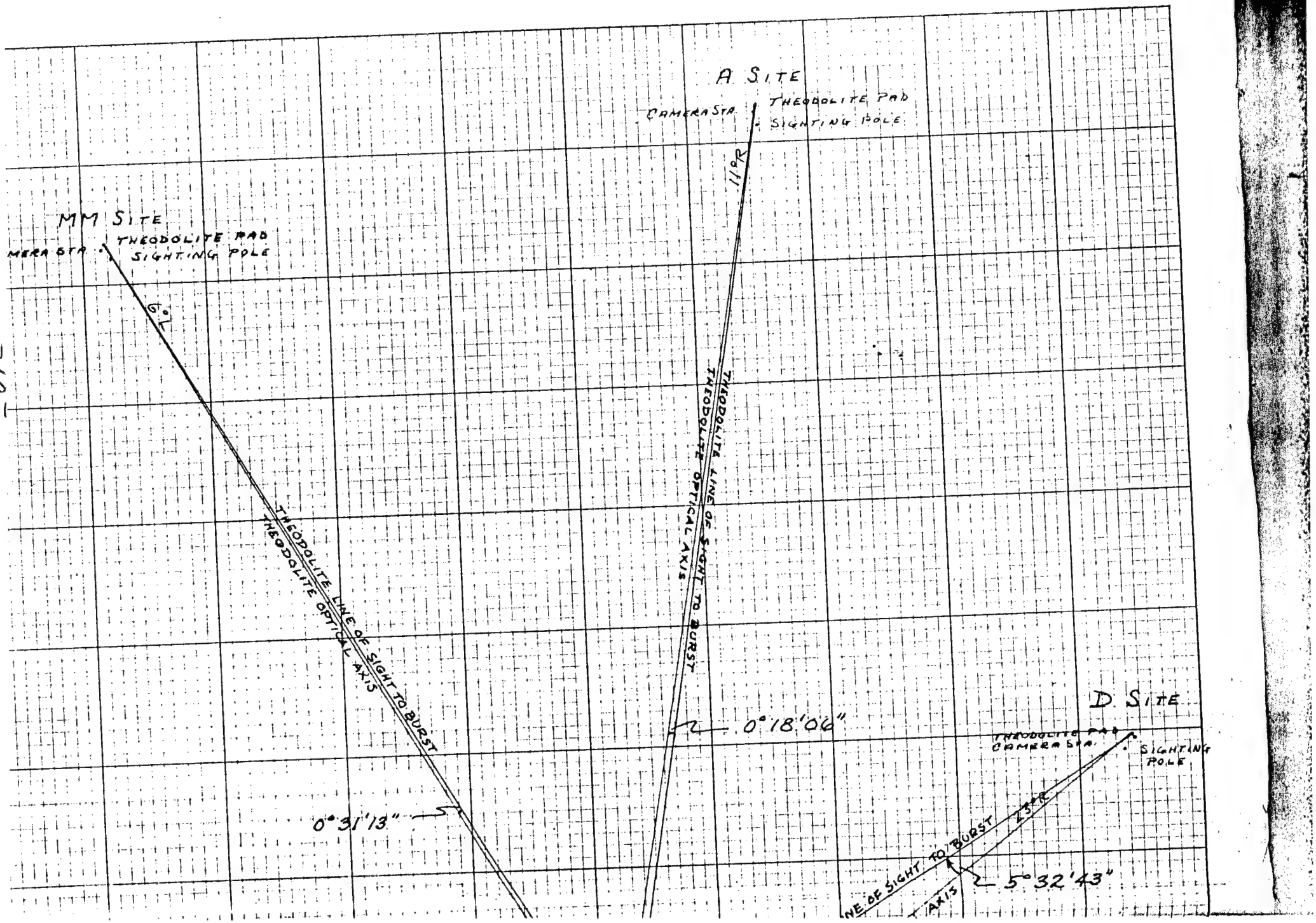

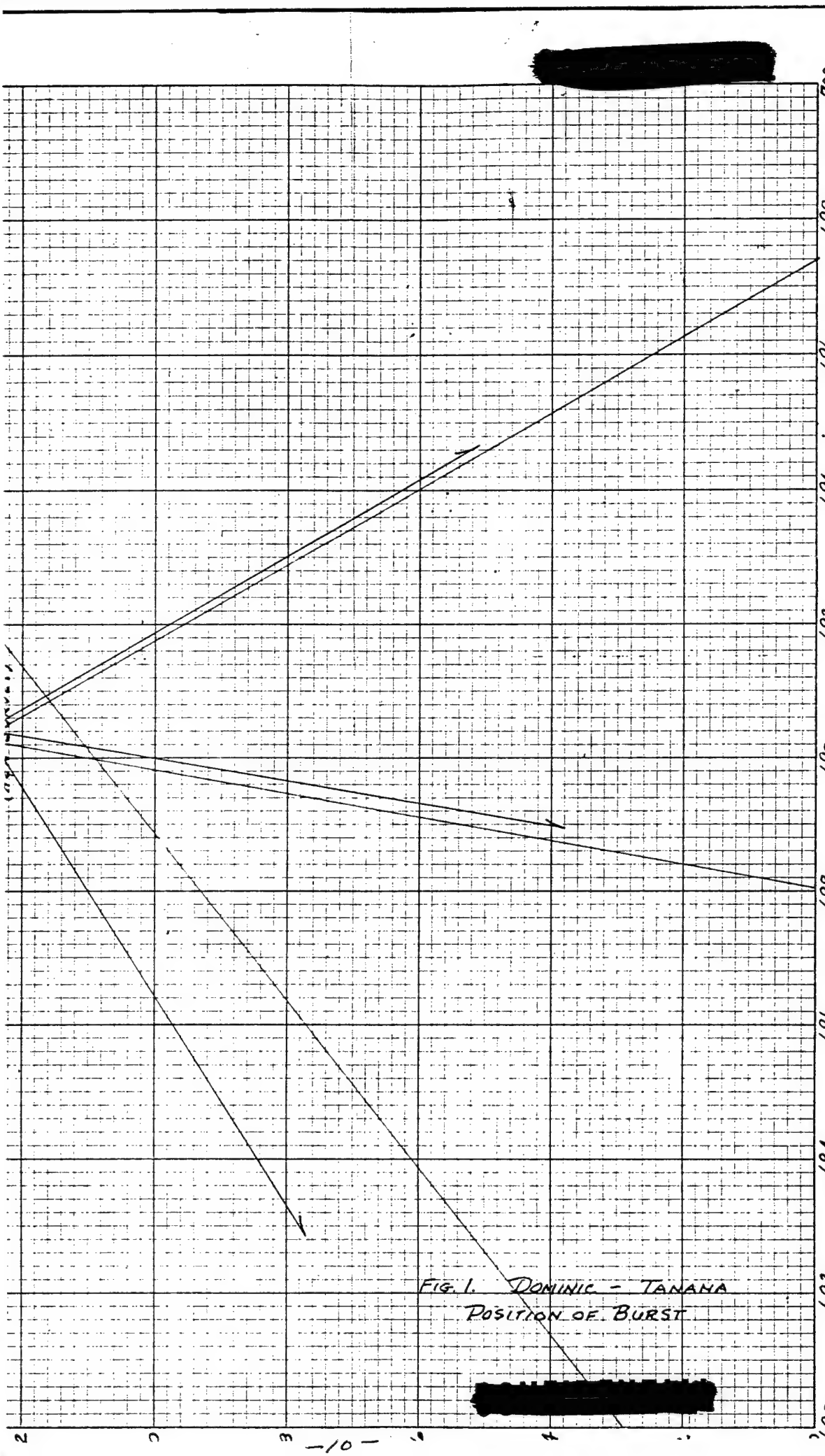

FIG. 1. DOMINIC - TANANA
POSITION OF BURST

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causing slight distortion as it grew toward the edge of the frame. The Dynafax at A Site did not record an image because it was aimed slightly higher than the other cameras on the mount and it could not encompass the fireball in its narrow field of view.

All twelve Rapatronics obtained fireball records, although heavy exposure on most films caused the data obtained to be somewhat less precise than usual. Measurements are included in Appendix D, and the results are plotted on D and MM Site Dynafax diameter-time curves. These curves were used to obtain the zero-frame times of exposure on the high-speed camera records.

3.0 YIELD DETERMINATION

The photographic plan was designed to record an expected 100-kt device with a brightness of 3×10^4 watts/meter^2 at minimum time, and the actual brightnesses experienced were about 10^6 watts/meter^2. For this reason the films were heavily exposed and, because of the small images, were in some cases quite difficult to analyze.

The yield as determined by a variable-phi scaling technique is 2.3 kt ± 0.3 kt. The Mach scaling method indicates a yield of 2.4 kt ± 0.4 kt. The yield figures are based on an extensive analysis of the four best high-speed Photo-Sonic records from the ground stations.

Because of the low yield of the Tanana device, ϕ^5 scaling techniques were not used. Mass effects and other factors prevented the diameter-time history from attaining the constant-growth region, indicated by a region of constant ϕ, which ϕ^5 scaling requires. For fireballs of variable growth rates it has been found that, although variable, the growth rates of devices

[redacted]

[redacted]

with ϕ-time curves of similar shape are comparable; thus the diameter-time histories lend themselves to scaling.

The yield of a device can therefore be determined by comparing its diameter-time behavior to that of a device of known yield according to the formula:

$$\frac{\omega_1}{\omega_2} = \frac{\rho_{o_1}\, \phi_1^5}{\rho_{o_2}\, \phi_2^5}$$

where ω = yield (kt)

ρ_o = ambient air density (grams/liter)

ϕ = D (meters)/$t^{2/5}$ (msec)

The diameter-time history of Tanana was scaled using this method, and comparisons were made with four shots from previous operations: Teapot-Moth, Teapot-Wasp, Ranger A, and Tumbler-Snapper 1. Detailed tabulations of the comparison of Tanana to each shot, together with the resultant yield figures, are presented in Tables 3 through 6. Table 7 summarizes the results from this method of analysis.

The Tanana ϕ-vs-time curve used in these calculations is presented in Fig. 2.

The Mach scaling method was also applied to the combined diameter-time data from the four best Photo-Sonic 4B records (Table 8). In this method of yield determination, a polynomial fit is made on all the data; and the resultant diameter-time curve, which represents the characteristic diameter-time behavior for this shot, is scaled to a theoretical 1-kt diameter-time curve. The coefficients of the polynomial to which the diameter-time data

[redacted]

[redacted]

were fitted by least squares are given below each tabulation, along with ambient pressure (mb), temperature (^{o}K), ambient sound velocity (m/msec), and the time interval over which the fit was made.

In an effort to eliminate the scatter which is especially apparent at early times, the Mach scaling method was also applied to the data derived from a smooth curve visually fitted to the composite plot of diameter vs time from all stations. The smoothed diameter-time curve is presented in Fig. 4, the data which were taken from it are shown in Table 9, and the Mach scaling results are contained in Table 10. The yield by Mach scaling is taken to be the average of these results and the results of the calculations made on the composite data from the four best films. The limits include 80 percent of the scatter apparent in both calculations.

Complete ϕ^5 yield calculations for each film, valuable chiefly for their tabulation of diameter, time, and phi, are given on the IBM printout sheets contained in Appendix C.

Plots of diameter vs time and phi vs time for the data from each station are shown in Figs. 5 through 13. Composite plots for the complete sets of data are given in Figs. 14 and 15. Diameter measurements and camera data calculation sheets for each film are included in Appendix D.

An air density of 0.891 grams per liter was calculated for an altitude of 9,030 feet above MSL, based on an H+15 minute observation by JTF-8 Weather Central, which reported a pressure of 737 mb, a temperature of 15.0^{o}C, and a relative humidity of 39% at that altitude.

Examples of fireball photography are included in Appendix E.

[redacted]

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Table 3. Tanana ϕ scaled to Teapot-Moth.

Time (msec)	ϕ_1 (Tanana)	ϕ_2 (Moth)	ϕ_1/ϕ_2	$(\phi_1/\phi_2)^5$	ω (kt)
1.6	49.0	46.6	1.052	1.288	2.27
2.4	48.7	46.3	1.051	1.282	2.27
3.2	48.4	46.1	1.051	1.282	2.27
4.0	48.0	45.8	1.048	1.264	2.23
5.0	47.6	45.6	1.043	1.234	2.19
5.5	47.4	45.5	1.042	1.228	2.16
6.0	47.2	45.4	1.040	1.217	2.14
6.5	47.0	45.3	1.038	1.205	2.14
7.0	46.8	45.2	1.035	1.188	2.10
7.5	46.7	45.1	1.035	1.188	2.10
8.0	46.5	45.0	1.033	1.176	2.07
9.0	46.2	44.95	1.028	1.148	2.03

[redacted]

[redacted]

Table 4. Tanana ϕ scaled to Teapot-Wasp.

Time (msec)	ϕ_1 (Tanana)	ϕ_2 (Wasp)	ϕ_1/ϕ_2	$(\phi_1/\phi_2)^5$	ω (kt)
1.6	49.0	40.9	1.200	2.488	2.23
2.4	48.7	40.5	1.202	2.510	2.25
3.2	48.4	40.2	1.204	2.530	2.28
4.0	48.0	39.7	1.209	2.584	2.32
5.0	47.6	39.3	1.211	2.605	2.34
5.5	47.4	39.0	1.220	2.702	2.43
6.0	47.2	38.7	1.220	2.702	2.43
6.5	47.0	38.6	1.220	2.702	2.43
7.0	46.8	38.3	1.220	2.702	2.43
7.5	46.7	38.0	1.230	2.815	2.53
8.0	46.5	37.7	1.230	2.815	2.53

[redacted]

[redacted]

Table 5. Tanana ϕ scaled to Ranger A.

Time (msec)	ϕ_1 (Tanana)	ϕ_2 (Ranger A)	ϕ_1/ϕ_2	$(\phi_1/\phi_2)^5$	ω (kt)
1.6	49.0	42.7	1.148	1.994	2.08
2.4	48.7	42.5	1.146	1.997	2.07
3.2	48.4	41.9	1.155	2.055	2.15
4.0	48.0	41.4	1.159	2.091	2.18
5.0	47.6	40.8	1.167	2.164	2.26
5.5	47.4	40.6	1.169	2.183	2.29
6.0	47.2	40.3	1.173	2.220	2.32
6.5	47.0	40.0	1.175	2.240	2.35
7.0	46.8	39.8	1.208	2.571	2.69
7.5	46.7	39.6	1.181	2.297	2.40
8.0	46.5	39.3	1.183	2.316	2.30

[redacted]

[redacted]

Table 6. Tanana ϕ scaled to Tumbler-Snapper 1[1].

Time (msec)	ϕ_1 (Tanana)	ϕ_2 (TS-1)	ϕ_1/ϕ_2	$(\phi_1/\phi_2)^5$	ω (kt)
1.6	49.0	42.2	1.163	2.13	2.36
2.4	48.7	41.8	1.165	2.15	2.39
3.0	48.5	41.5	1.167	2.16	2.41
3.5	48.3	41.2	1.171	2.20	2.45
4.0	48.0	40.9	1.173	2.22	2.47
4.5	47.8	40.7	1.174	2.23	2.47
5.0	47.6	40.5	1.176	2.25	2.50

1. A yield value of 1.33 kt, the average of the fireball and radio-chemical yields, was used.

[redacted]

[redacted]

Table 7. Summary of Ø scaling results.

	Yield (kt)	Air Density (g/l)	Yield of Tanana as scaled to this shot (kt)
Teapot-Moth	2.23	1.124	2.16
Teapot-Wasp	1.11	1.101	2.38
Ranger A	1.27	1.081	2.29
Tumbler-Snapper 1	1.33	1.066	2.44
			Avg. = 2.32

[redacted]

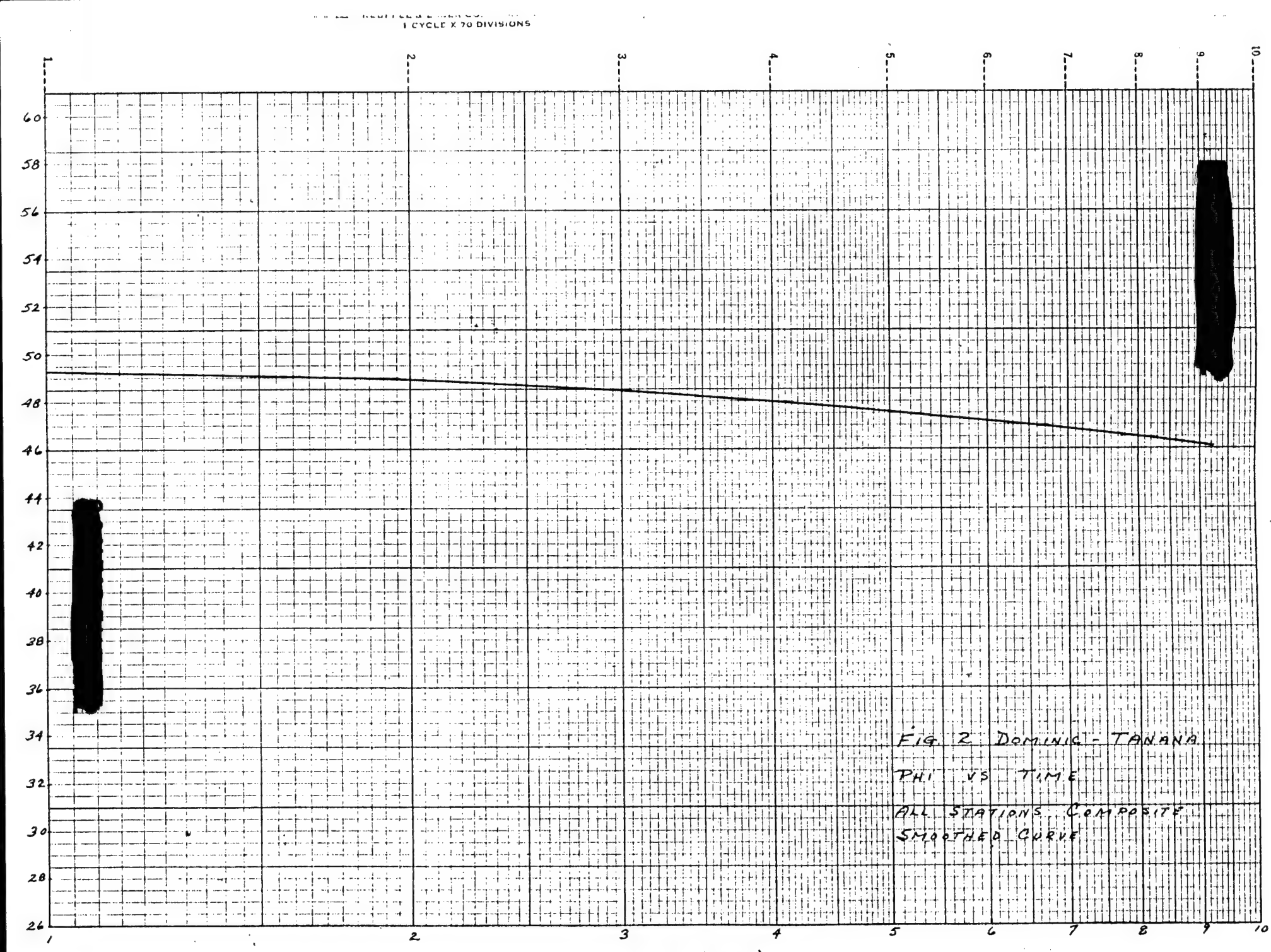

FIG. 2 DOMINICI - TANANA

PHI VS TIME

ALL STATIONS COMPOSITE

SMOOTHED CURVE

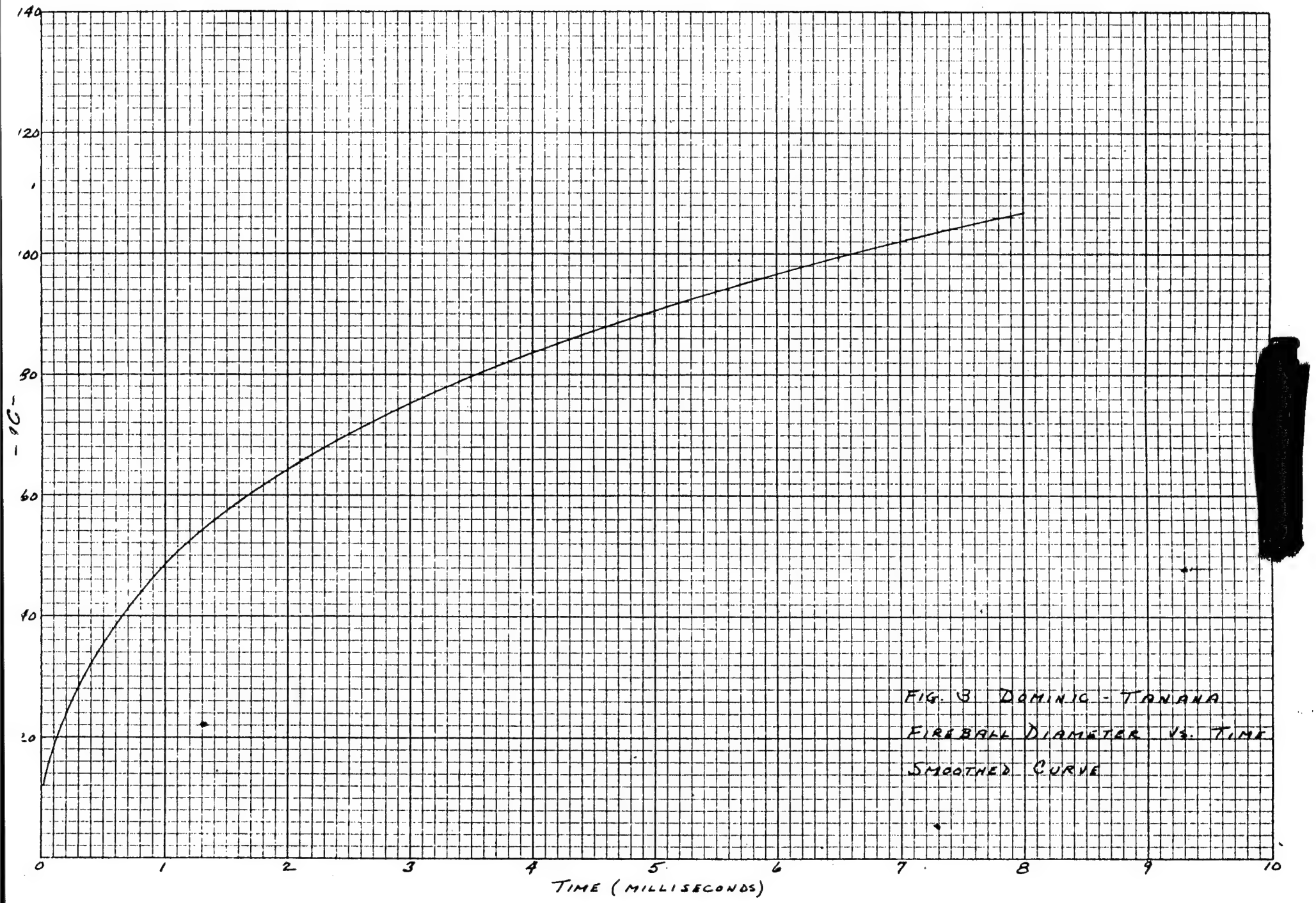

FIG. 8 DOMINIC - TANANA
FIREBALL DIAMETER VS. TIME
SMOOTHED CURVE

Table 8. Mach scaling, four Photo-Sonic 4B records.

OPERATION		DOMINIC	
SHOT	STATION	CAMERA	FILM
TANANA	MM	PS4B4	106048
TANANA	D	PS4B6	106047
TANANA	MM	PS4B3	106053
TANANA	A	PS4B2	106051

W(KT)= +2.29 DW(KT)= +.32

TIME(MS)	DIAM(M)	MACH NO.	W(KT)
+3.20	+77.19	+13.03	+2.62
+3.60	+80.59	+11.90	+2.48
+4.00	+83.72	+11.01	+2.37
+4.40	+86.63	+10.29	+2.29
+4.80	+89.37	+9.71	+2.23
+5.20	+91.96	+9.23	+2.19
+5.60	+94.43	+8.83	+2.17
+6.00	+96.80	+8.50	+2.16
+6.40	+99.08	+8.22	+2.16
+6.80	+101.30	+7.98	+2.18

A=-.34267E+02 B=+.11020E+03 C=-.34665E+02 D=+.59113E+01
D2=+.28290E+02 P=+.73700E+03 T=+.28800E+03C0=+.34190E-00
DATA FIT BETWEEN T= +2.00 AND T= +8.00

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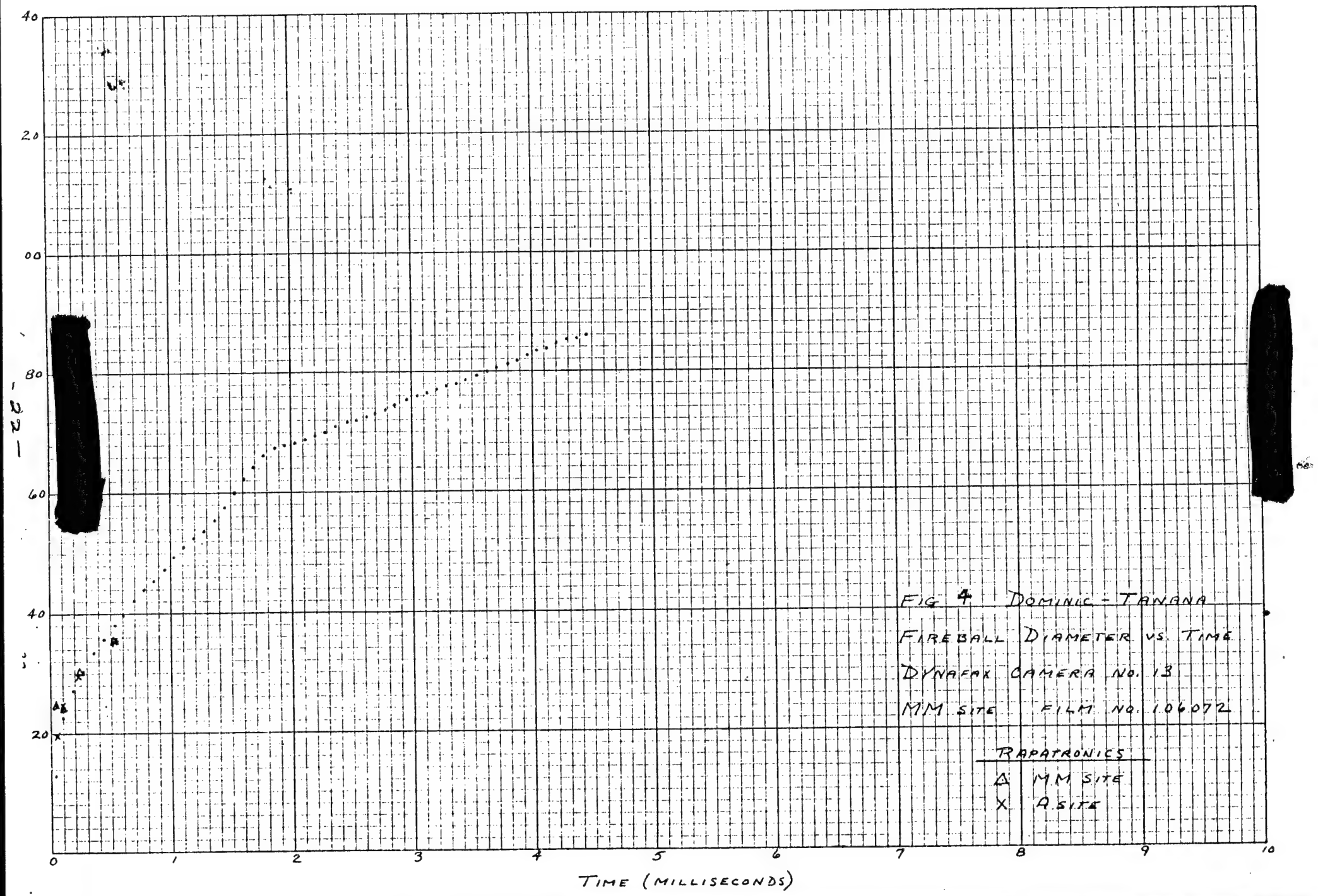


FIG 4 DOMINIC - TANANA
FIREBALL DIAMETER VS. TIME
DYNAFAX CAMERA NO. 13
MM SITE FILM NO. 1.06.072

RAPATRONICS
△ MM SITE
X A SITE

Table 9. Data from composite diameter-time curve.

OPERATION DOMINIC

TANANA COMPOSITE DIAMETER-TIME CURVE

DIAMETER	TIME
+18.50	+0.10
+24.00	+0.20
+28.30	+0.30
+32.20	+0.40
+35.50	+0.50
+38.40	+0.60
+41.40	+0.70
+43.90	+0.80
+46.30	+0.90
+48.60	+1.00
+57.40	+1.50
+64.30	+2.00
+70.20	+2.50
+75.30	+3.00
+79.70	+3.50
+83.60	+4.00
+87.20	+4.50
+90.50	+5.00
+93.70	+5.50
+96.70	+6.00
+99.50	+6.50
+102.10	+7.00
+104.50	+7.50
+106.80	+8.00

[redacted]

Table 10. Mach scaling results on composite diameter-time curve.

OPERATION DOMINIC

TANANA COMPOSITE DIAMETER-TIME CURVE

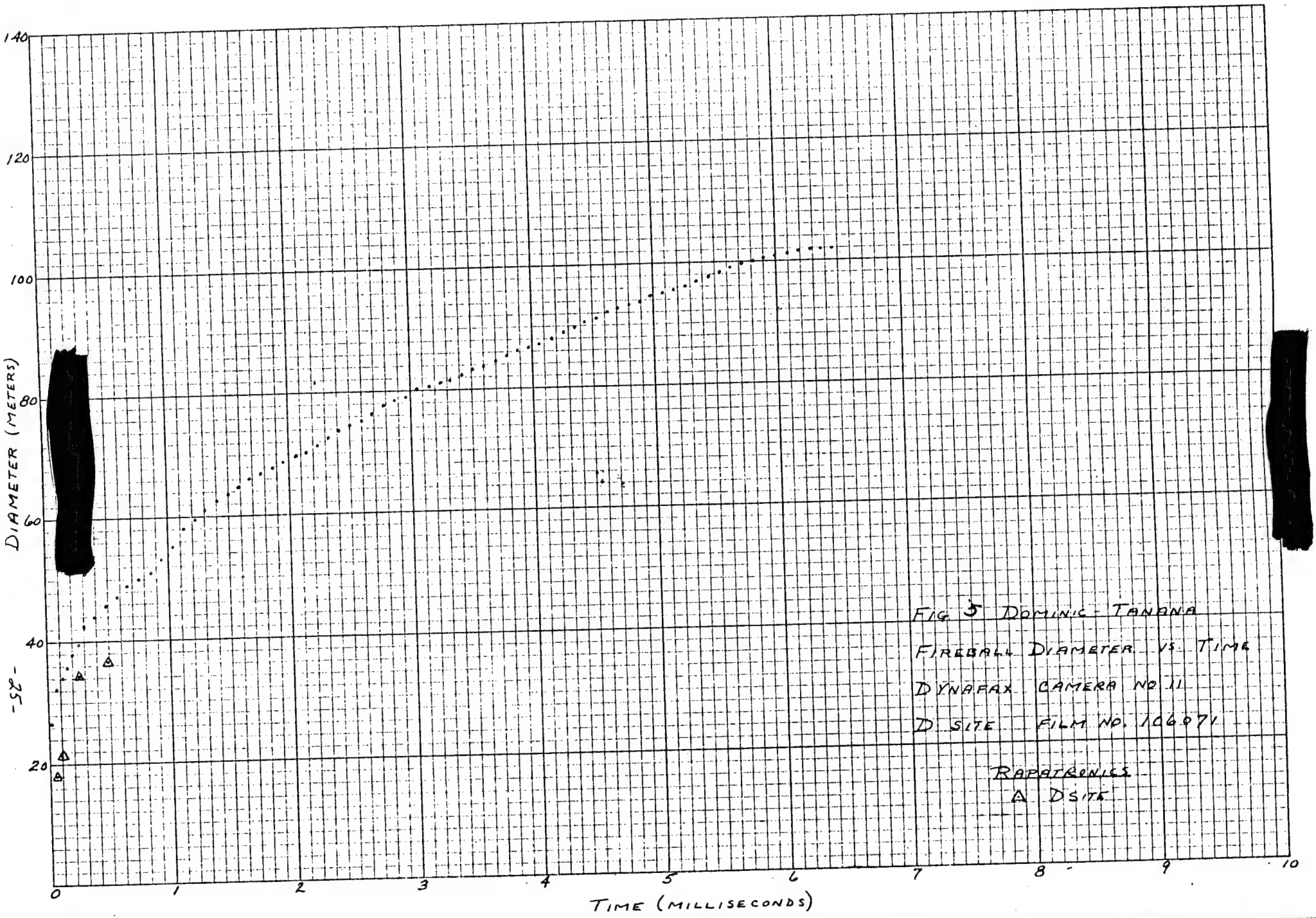
W(KT)= +2.49 DW(KT)= +.91

TIME(MS)	DIAM(M)	MACH NO.	W(KT)
+1.68	+59.64	+21.09	+2.96
+2.20	+66.56	+17.56	+2.94
+2.73	+72.42	+15.12	+2.88
+3.26	+77.53	+13.31	+2.77
+3.78	+82.05	+11.88	+2.61
+4.31	+86.12	+10.73	+2.45
+4.83	+89.81	+9.77	+2.29
+5.36	+93.18	+8.95	+2.14
+5.89	+96.27	+8.24	+1.99
+6.41	+99.12	+7.61	+1.85

A=-.18087E+01 B=+.47740E+02 C=+.41375E+01 D=-.19129E+01
D2=+.25700E+01 P=+.73700E+03 T=+.28800E+03C0=+.34190E-00
DATA FIT BETWEEN T= +.10 AND T= +8.00

[redacted]

K+E 10 X 10 TO THE INCH 359-5
KEUFFEL & ESSER CO. MADE IN U.S.A.



KEUFFEL & ESSER CO. MADE IN U.S.A.

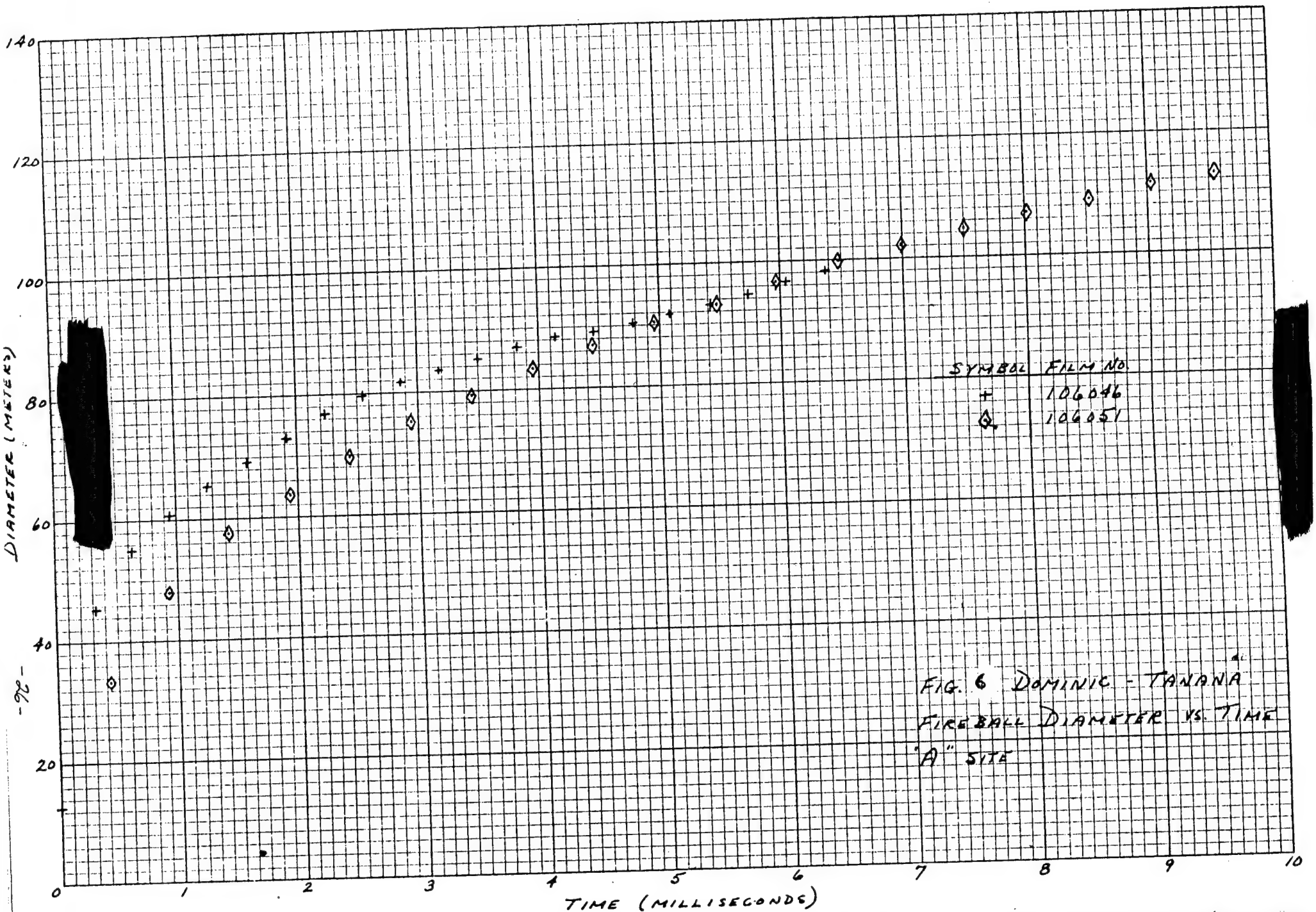
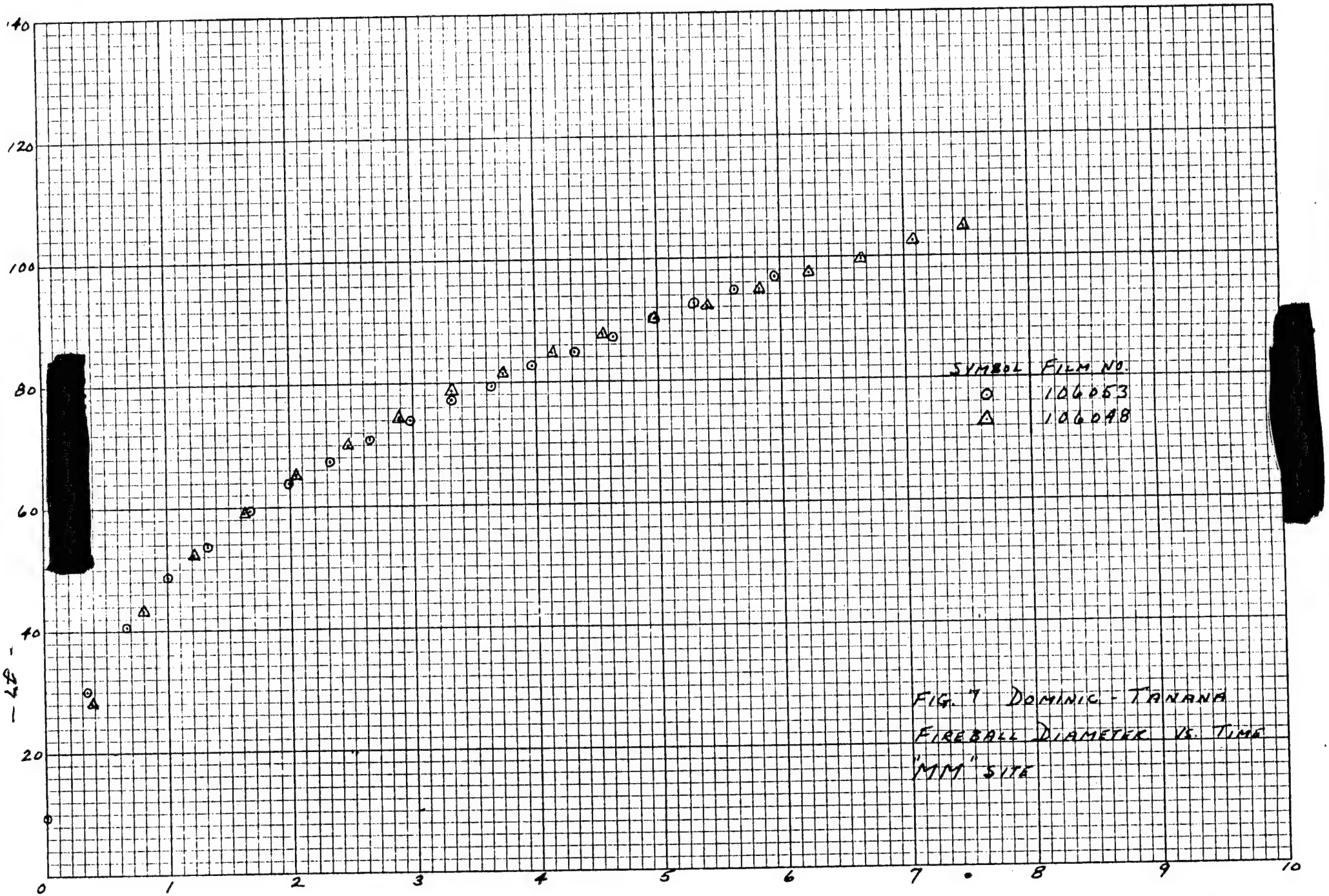


FIG. 6 DOMINIC - TANANA
FIREBALL DIAMETER VS. TIME
"A" SITE


140
120
100
80
60
40
20
0
0
1
2
3
4
5
6
7
8
9
10
SYMBOL FILM NO.
106053
106048
FIG. 7 DOMINIC - TANANA
FIREBALL DIAMETER VS. TIME
"MM" SITE

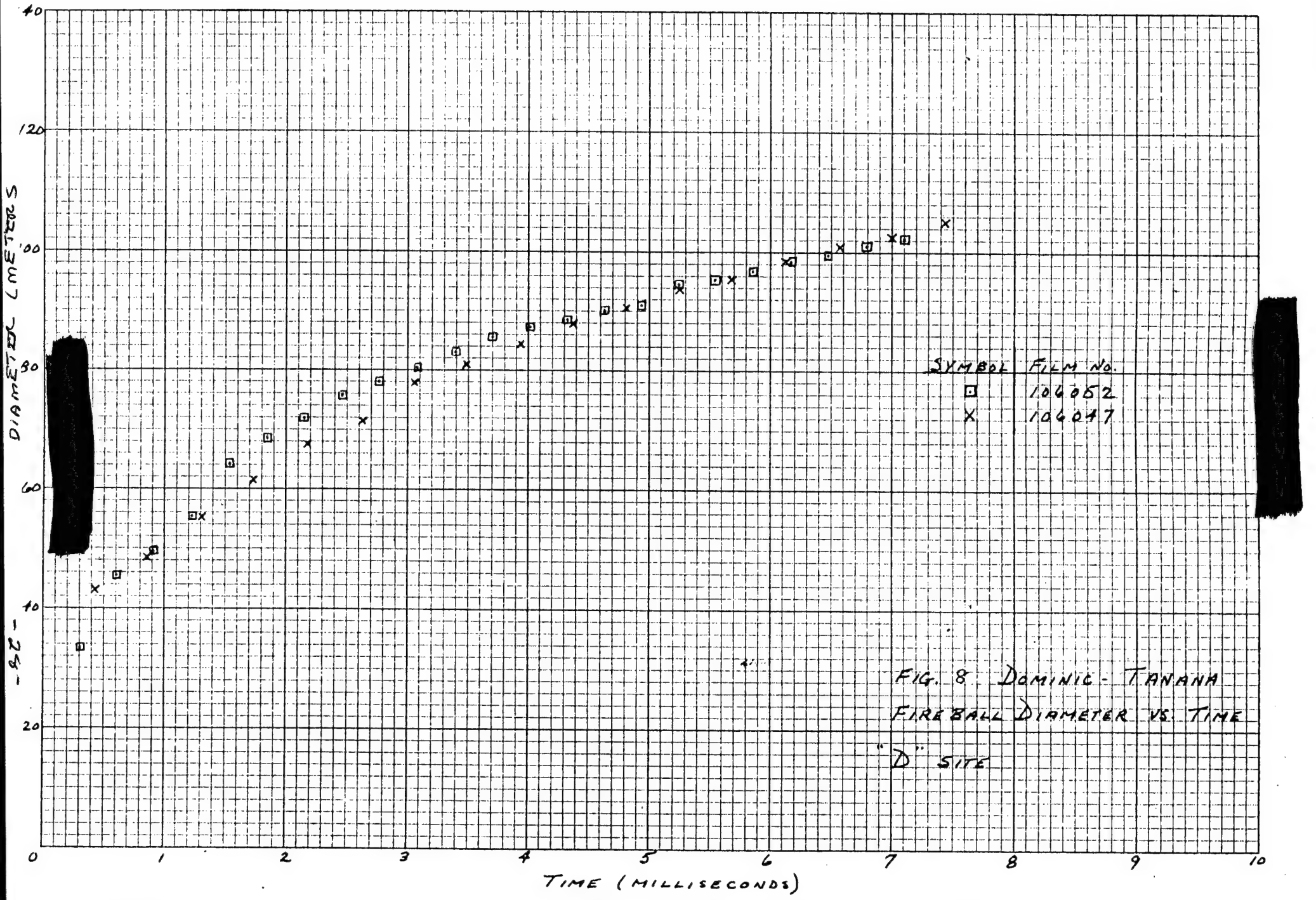


FIG. 8 DOMINIC - TANANA
FIREBALL DIAMETER VS. TIME
"D" SITE

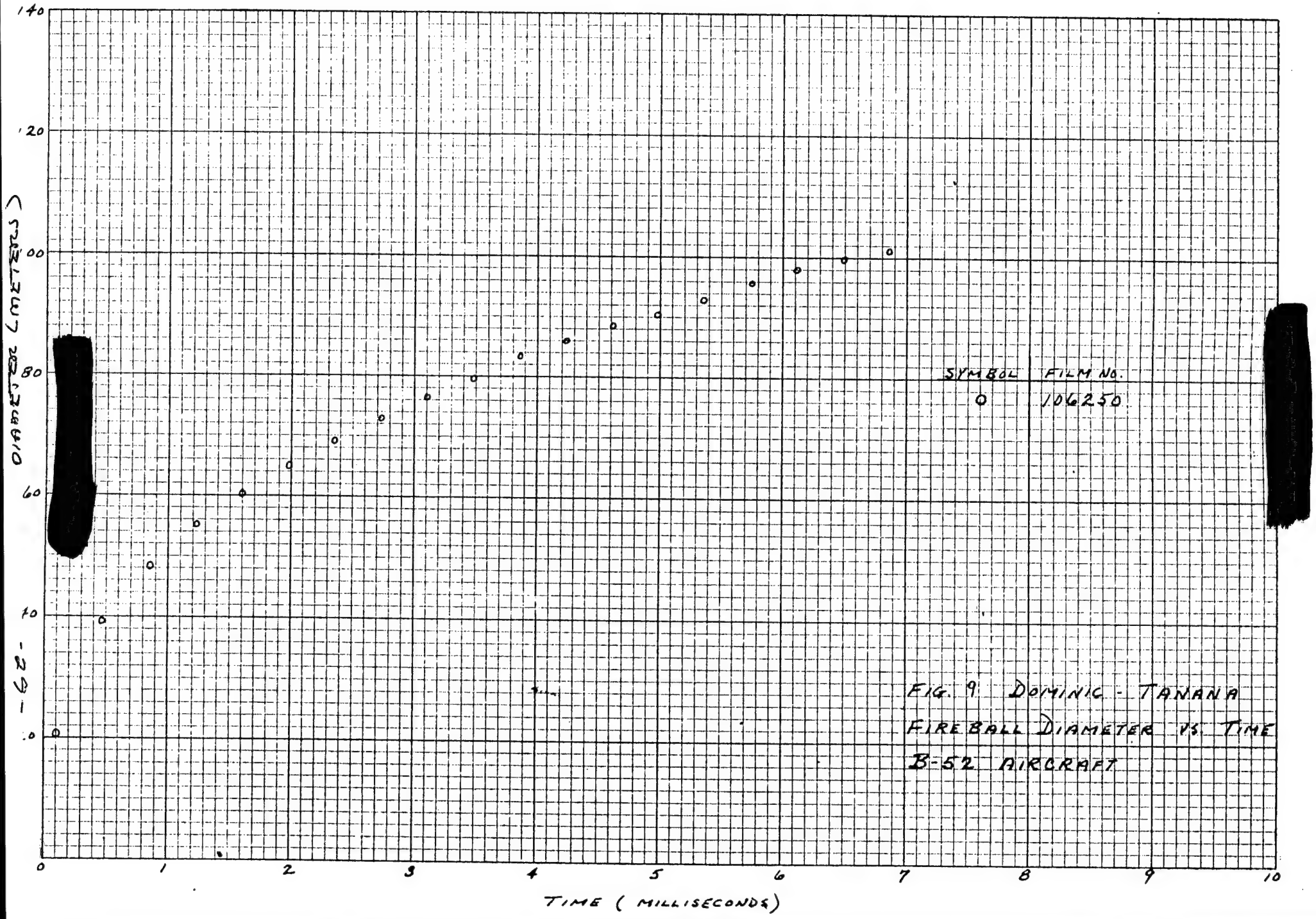


FIG. 9 DOMINIC - TANANA
FIREBALL DIAMETER VS. TIME
B-52 AIRCRAFT

KEUFFEL & ESSER CO. MADE IN U.S.A.
2 CYCLES X 70 DIVISIONS

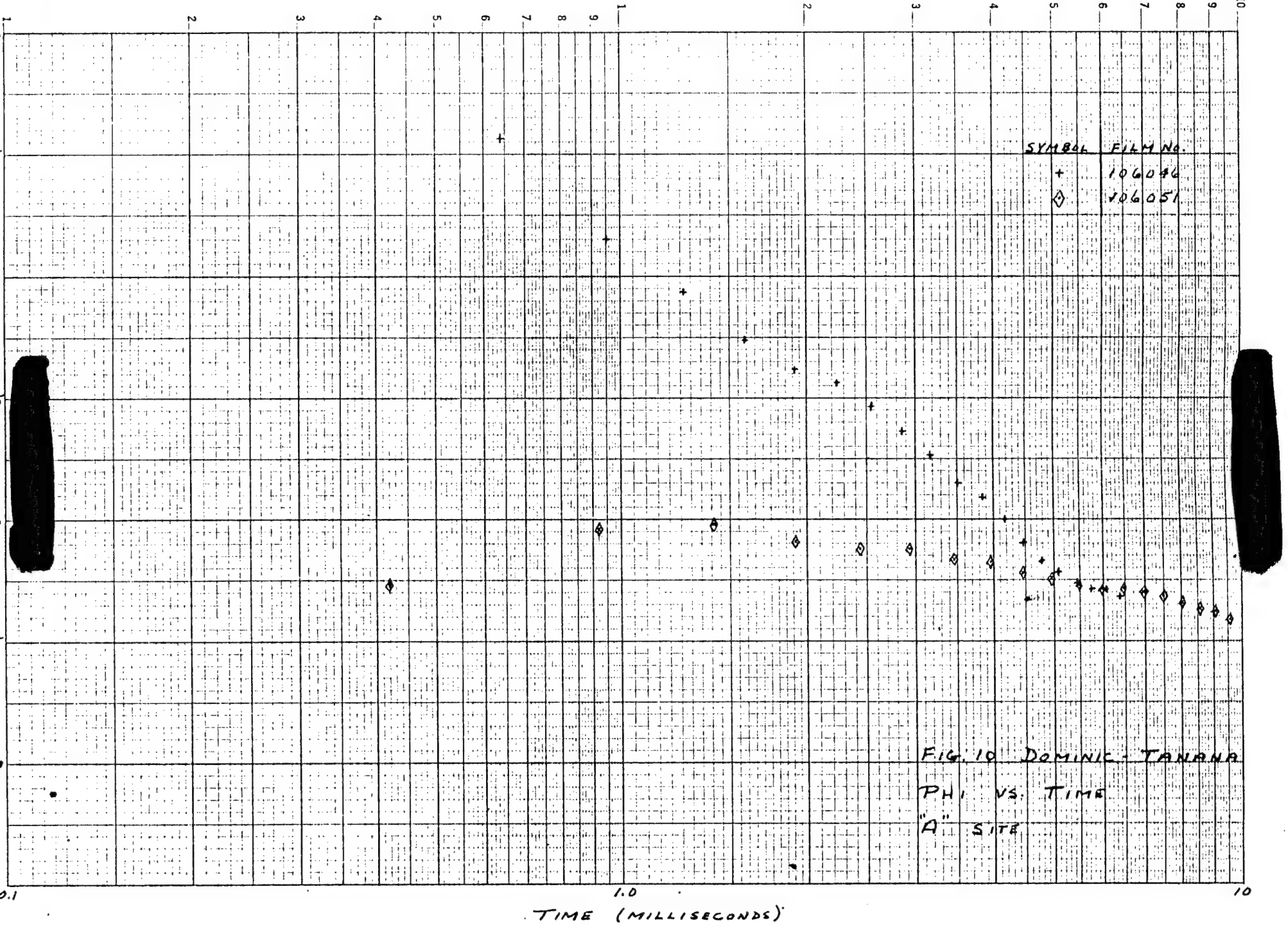


FIG. 10 DOMINIC - TANANA
PHI VS. TIME
"A" SITE

KEUFFEL & ESSER CO. MADE IN U.S.A.
2 CYCLES X 70 DIVISIONS

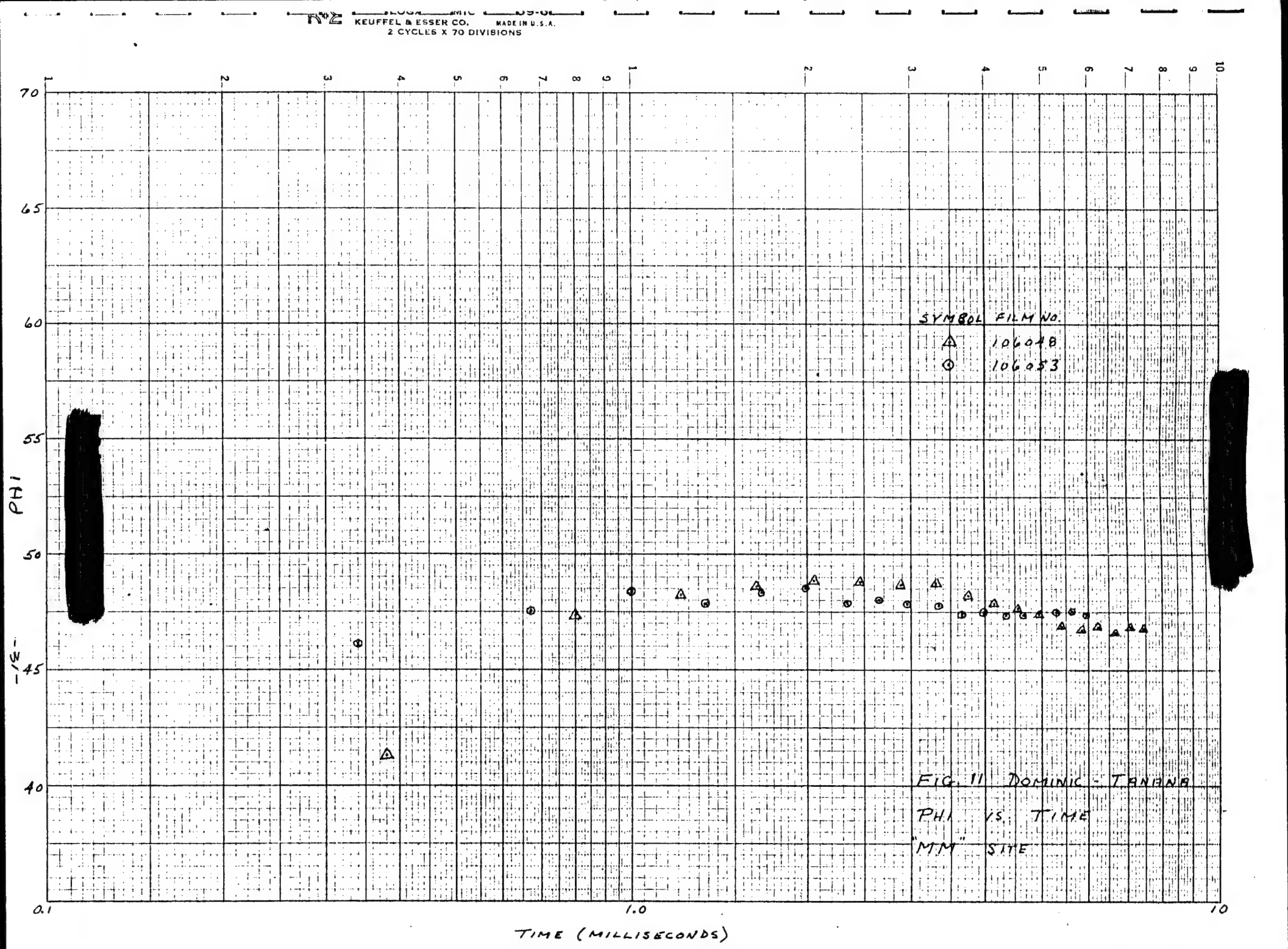


FIG. 11 DOMINIC - TANANA
PHI VS. TIME
"MM" SITE

[redacted]

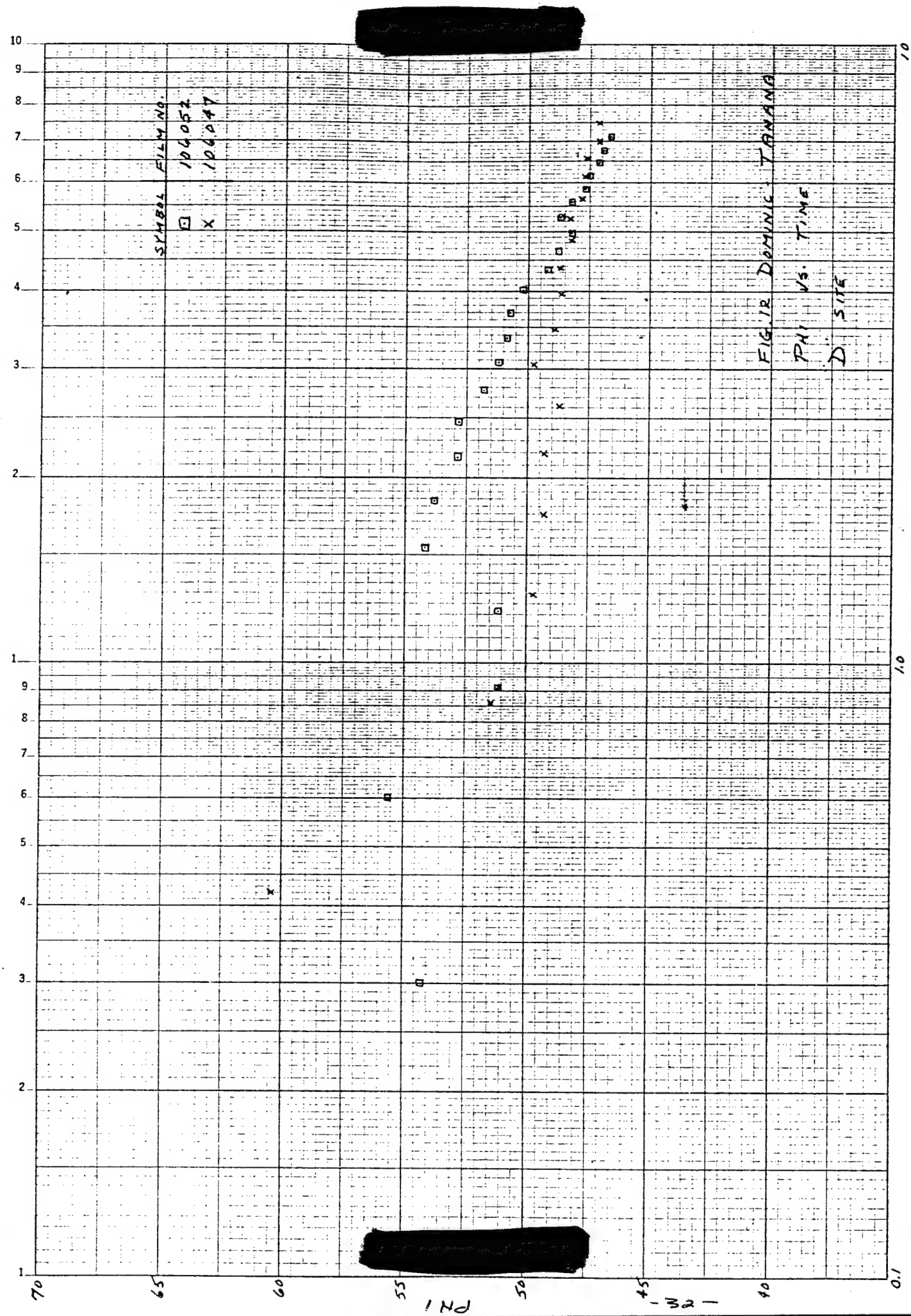


FIG. 12 DOMINIC TANANA

[redacted]

KEUFFEL & ESSER CO. MADE IN U.S.A.
2 CYCLES X 70 DIVISIONS

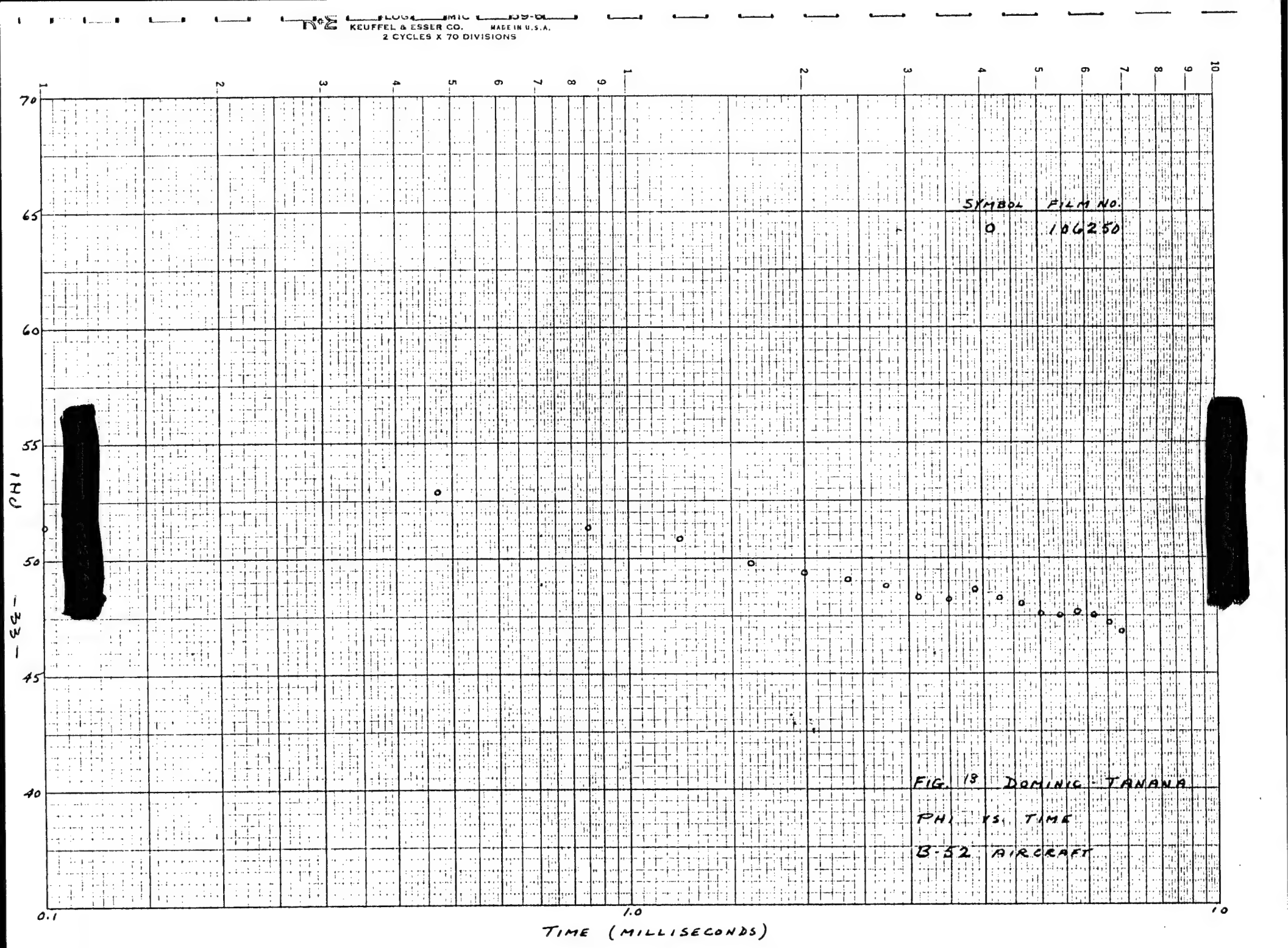


FIG. 19 DOMINIC - TANANA
PHI VS. TIME
B-52 AIRCRAFT

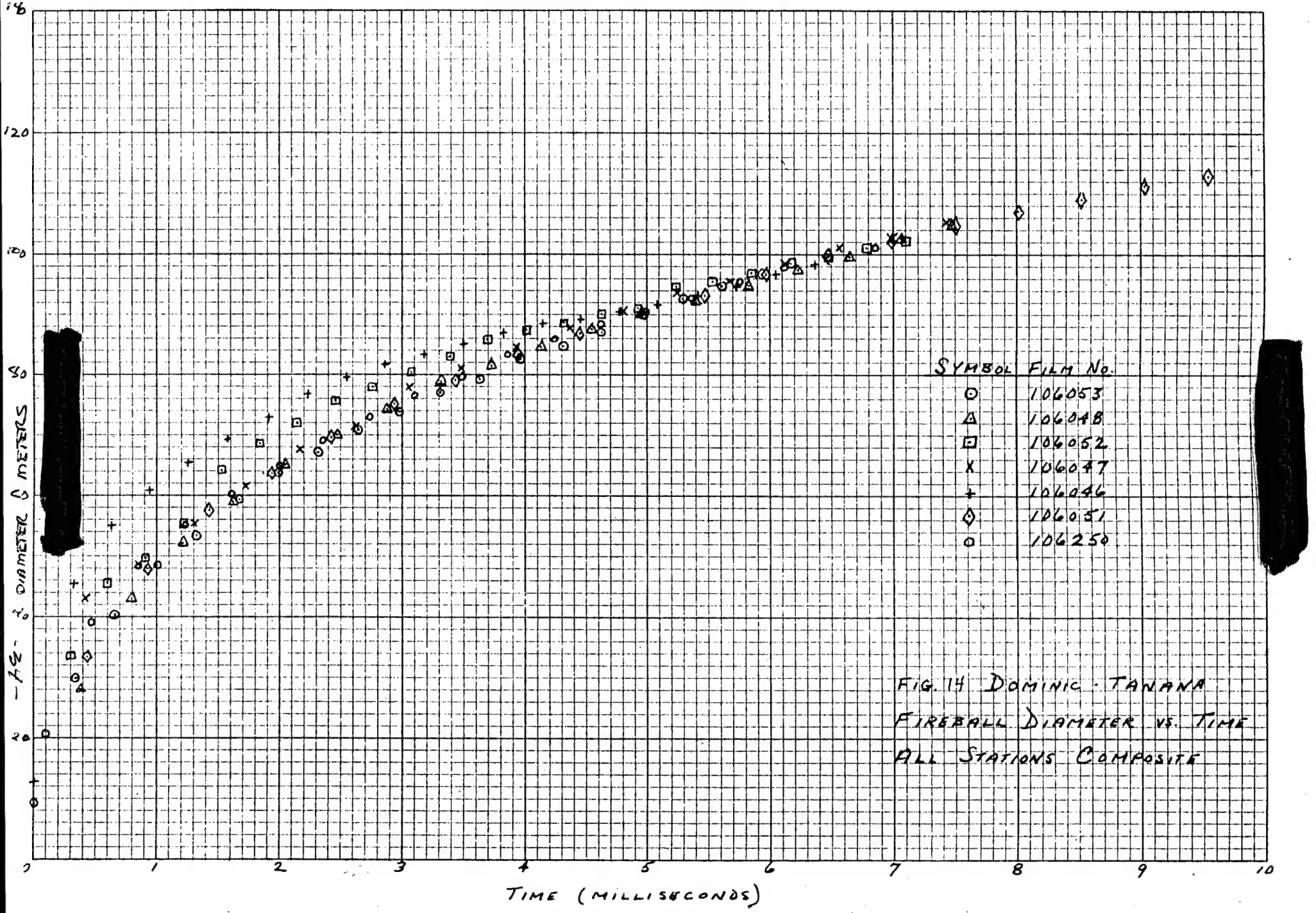


FIG. 14 DOMINIC - TANANA
FIREBALL DIAMETER VS. TIME
ALL STATIONS COMPOSITE

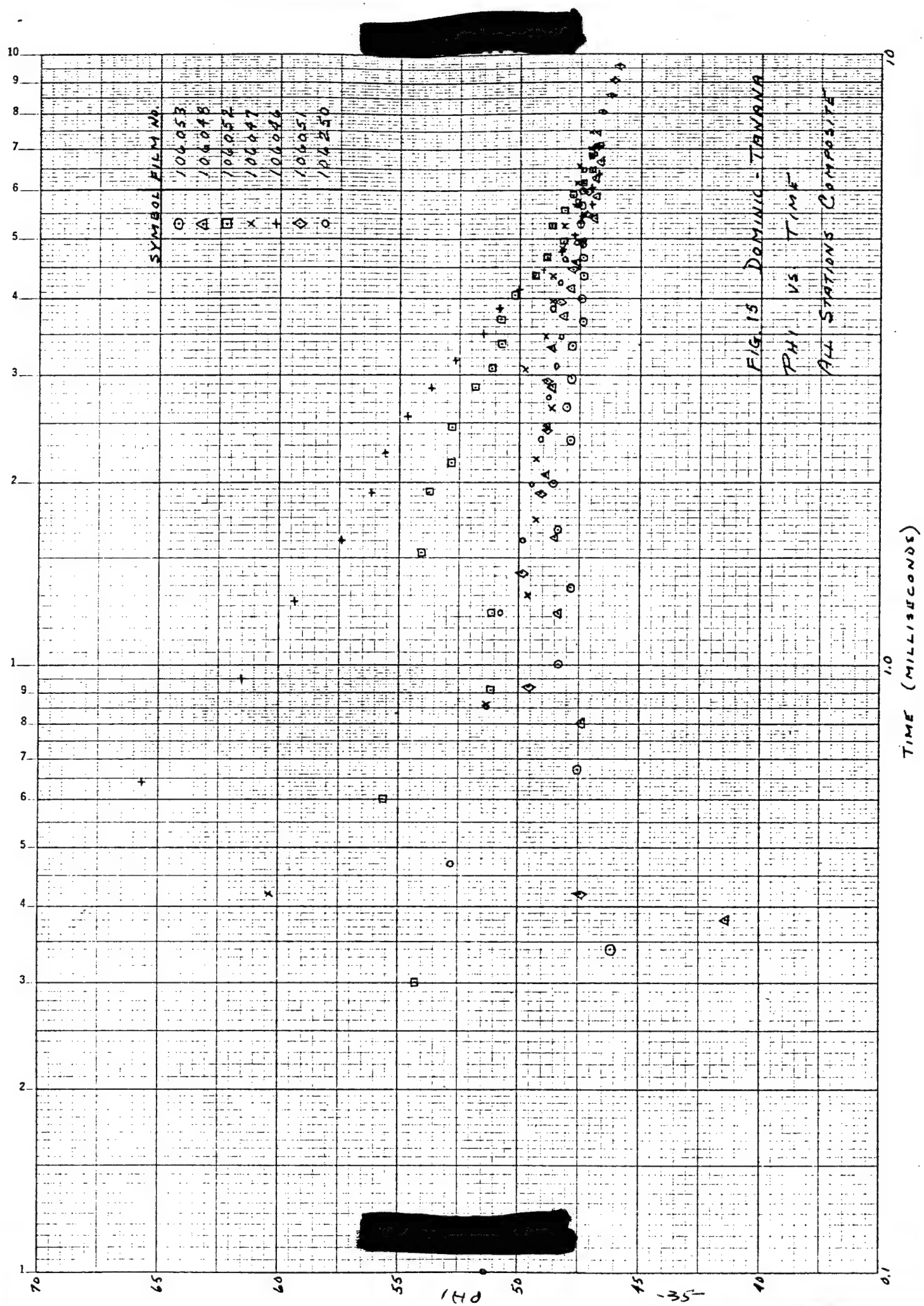


FIG 15 DOMINIC - TAWANA

[redacted]

APPENDIX A

PHOTO PLANS AND

PHOTO LOADING CHARTS,

SHOT TANANA

[redacted]

STATION NO. A

STATION TYPE ME-16

DISTANCE GZ 53,015.9'

DISTANCE OBJECT 53,767.7'

PHOTO PLAN

BRG 189°37'39"

	STATION	GZ	DIFF.	TILT
N	198,521.8	182,590.0	15,931.8	GZ 0°00'
E	693,112.6	690,410.0	2,702.6	OBJ 9°35'36"
Z	~10'	9030'	9020'	

EVENT TANANA

GZ STA. GZ-10

DATE 5/25/62

POSTED

CAMERA			LENS			FIELD TARGET H/V KFT	AIMING			POWER			MARKER		DELAY	FILM	PURPOSE	REMARKS
NO.	NOM SPD.	RACK POS.	FOC. MM	S/N	FILTER		OBJECT	H	V	VOLTS	SHUT RHEO.	TIME ON/OFF	TYPE	S/N				
DFX 12	24,000	ON E FWD	250	273532	W-12	2.24 1.63	BURST	ME-16	ME-16	90V DC	4.1 μsec	-2 sec +6 msec	MAG. TAPE	M 2928	-	FX	EARLY FB	
PS4B 1	3250	1	150	6962373	W-12	8.96 6.24				110V DC	36°	-4 sec +2 sec	200	32	-	MF	FB	
PS4B 2	3250	3	360	7118660	W-12	3.73 2.59				110V DC	9°	-2 sec +4 sec	200	27	-	DXN	FB	
PS10B 1	720	2	135	578295	W-12	22.73 11.67			↓	110V DC	15°	-2 sec +4 sec	200	32	-	MF	FB	
M-46	100	LOWER RIGHT	100	VA 5656	W-12	19.28 9.84		↓	9°40'	110V DC	60°	-5 sec +25 sec	200	27	-	MF	LATE FB	
WILD 233	-	THEOD. PAD	165	6820236	W-12	48.87 32.58		11°R	0°00' 00"	B.B.	1/500	-	-	-	-	MF	P.O.B.	
SPEED GRAPHIC	-	THEOD. PAD.	135	6926296	ND-3			11°R	0°00'	MANUAL	~1/500	~ Φ	-	-	-	47	P.O.B.	
RAP. 103	-	L-1	480	806429	W-12	5.59 5.59		ME-16	ME-16	120AC 28DC	4 μsec	-	-	-	55 μsec	PX	FB	
RAP. 101	-	L-2	480	806428	W-12	5.59 5.59				120AC 28DC	4 μsec	-	-	-	105 μsec	FX	FB	
RAP. 120	-	R-1	480	806417	W-12	5.59 5.59				120AC 28DC	4 μsec	-	-	-	233 μsec	FX	FB	
RAP. 118	-	R-2	480	806423	W-12	5.59 5.59	↓	↓	↓	120AC 28DC	4 μsec	-	-	-	527 μsec	MF	FB	
WILD 164	-	THEOD. PAD	165	-	W-12	48.87 32.58	BURST	11°R	0°00' 00"	B.B.	1/500	-	-	-	-	MF	P.O.B.	

REMARKS ① AIMING ANGLE OF THEODOLITE IS 11°00' TO RIGHT OF SIGHTING POLE

② RAPATRONIC RACK POSITIONS ARE TAKEN LOOKING DOWN AT TOP OF ME-16 MOUNT, L INDICATING LEFT OF TELESCOPE BARREL & R INDICATING RIGHT OF TELESCOPE BARREL

③ RAPATRONIC TIMES OF EXPOSURE TO BE INCREASED BY 2 μsec ½ COIL DELAY

5/20/62 7/31/62

FORM E60 A

EDGERTON, GERMESHAUSEN & GRIER, INC.

PHOTO LOADING CHART

STATION A EVENT TANANA DATE 5/25/62

FILM					CAMERA			LENS		EXPOSURE			REMARKS
TYPE	EMULS. NO.	SIZE	HOLDER	PERF. NO.	NO.	RACK POS.	NOM. SPD.	FOC. MM	FILTER	APER	SHUTTER RHEO.	W/M²	
FX	5240725	35/33 7/8"	CASSETTE	106070	DFX 12	ON E FWD	24,000	250	W-12	F̄ = 100	4.1 μsec	10^7	
MF	0-112-16	35/1000	MAG	106046	PS4B 1	1	3250	150	W-12	2.8	36°	2.8×10^4	
DXN	5222-221	35/1000	MAG	106051	PS4B 2	3	3250	360	W-12	11	9°	2.8×10^4	
MF	0-112-13	70/400	MAG	106054	PS10B 1	2	720	135	W-12	4	15°	2.8×10^4	
MF	0-112-14	35/200	MAG	106059	M-46	LOWER RIGHT	100	100	W-12	2.8	60°	250	
MF	074-01	10x15cm	PLATE HOLDER	106066	WILD 233	THEOD. PAD	–	165	W-12	–	1/500	–	
47	–	4" x 5"	HOLDER	–	SPEED GRAPHIC	THEOD. PAD	–	135	ND-3	32	1/500	–	
PX		2 1/4" x 3 1/4"	CUT FILM	106085	RAP. 103	L-1	–	480	W-12	F̄ = 120	4 μsec	5×10^6	
FX	6140868	↓	↓	106074	RAP. 101	L-2	–	480	W-12	↓	4 μsec	1.5×10^7	
FX	6140868			106075	RAP. 120	R-1	–	480	W-12		4 μsec	5×10^7	
MF	0-112-13			106082	RAP. 118	R-2	–	480	W-12		4 μsec	1×10^8	
MF	074-01	10x15cm	PLATE HOLDER	106089	WILD 164	THEOD. PAD	–	165	W-12	–	1/500	–	

DATE FILM LOADED _____ DATE CAMERA LOADED _____ DATE EXPOSED 5/25/62

REMARKS _____

DJB 5/20/62 7/24/62

FORM E-40

EDGERTON, GERMESHAUSEN & GRIER, INC.

STATION NO. MM

STATION TYPE ME-16

DISTANCE GZ 53,077.7'

DISTANCE OBJECT 53,828.9'

PHOTO PLAN

BRG 149°54'54" EVENT TANANA

GZ STA. GZ-10

DATE 5/25/62

POSTED

	STATION	GZ	DIFF.	TILT
N	196,588.8	182,590.0	13,998.8	GZ 0°00'
E	682,300.1	690,410.0	8,109.9	OBJ 9°34'56"
Z	~10'	9030'	9020'	

CAMERA NO.	MOM EPO.	RACK POS.	LENS FOC. MM	LENS S/N	FILTER	FIELD TARGET H/V	AIMING OBJECT	AIMING H	AIMING V	POWER VOLTS	POWER SHUT RHEO.	POWER TIME ON/OFF	MARKER TYPE	MARKER S/N	DELAY	FILM	PURPOSE	REMARKS
DFX 13	26,000	ON E FWD	250	273626	W-12	2.21 1.64	BURST	ME-16	ME-16	90V DC	4.1 μsec	-2sec +6msec	MAG. TAPE	M 2887	–	FX	EARLY FB	
PS4B 3	3250	3	360	7118607	W-12	3.74 2.59				110V DC	9°	-4sec +2sec	200	33	–	DXN	FB	
PS4B 4	3250	1	150	7248438	W-12	8.97 6.24				110V DC	36°	-2sec +4sec	200	30	–	MF	FB	
PS10B 3	720	2	135	578376	W-12	22.76 11.68				110V DC	15°	-2sec +4sec	200	30	–	MF	FB	
M-47	100	LOWER RIGHT	100	339547	W-12	13.30 9.85			9°40'	110V DC	60°	-5sec +25sec	200	33	–	MF	LATE FB	
WILD 147	–	THEOD. PAD	165	–	W-12	48.93 32.62		6°L	0°00' 00"	B.B.	1/500	–	–	–	–	MF	P.O.B.	
POLAROID	–	THEOD. PAD.	~5.5"	–	ND-2			6°L	0°00'	MANUAL	~1/50	~ ϕ	–	–	–	42	P.O.B.	
RAP 107	–	L-1	480	806414	W-12	5.60 5.60		ME-16	ME-16	120V AC 28V DC	4μsec	–	–	–	52 μsec	PX	FB	
RAP 105	–	L-2	480	806421	W-12	5.60 5.60					4μsec	–	–	–	99 μsec	FX	FB	
RAP 108	–	R-1	480	806418	W-12	5.60 5.60					4μsec	–	–	–	213.9 μsec	FX	FB	
RAP 114	–	R-2	480	806427	W-12	5.60 5.60					4μsec	–	–	–	523.2 μsec	MF	FB	
WILD 148	–	THEOD. PAD	165	–	W-12	48.93 32.62	BURST	6°L	0°00'	B.B.	1/500	–	–	–	–	MF	P.O.B.	

REMARKS ① AIMING ANGLE OF THEODOLITE IS 6°00' TO LEFT OF SIGHTING POLE

② RAPATRONIC TIMES OF EXPOSURE TO BE INCREASED BY 2 μSEC 1/2 COIL DELAY

WB 5-20/62 7/24/62

FORM E 60 A

EDGERTON, GERMESHAUSEN & GRIER, INC.

PHOTO LOADING CHART

STATION MM EVENT TANANA DATE 5/25/62

FILM					CAMERA			LENS		EXPOSURE			REMARKS
TYPE	EMULS NO.	SIZE	HOLDER	PERF. NO.	NO.	RACK POS.	NOM. SPD.	FOC. MM	FILTER	APER	SHUTTER RHEO.	W/M²	
FX	5240725	35/33 7/8"	CASSETTE	106072	DFX 13	ON E FWD	26,000	250	W-12	F=100	4.1 μsec	10^7	
DXN	5222-221	35/1000	MAG	106053	PS4B 3	3	3250	360	W-12	11	9°	2.8×10^4	
MF	0-112-16	35/1000	MAG	106048	PS4B 4	1	3250	150	W-12	4	36°	2.8×10^4	
MF	0-112-13	70/400	MAG	106056	PS10B 3	2	720	135	W-12	4	15°	2.8×10^4	
MF	0-112-14	35/200	MAG	106061	M-47	LOWER RIGHT	100	100	W-12	2.8	60°	250	
MF	074-01	10x15cm	PLATE HOLDER	106069	WILD 147	THEOD. PAD	–	165	W-12	–	1/500	–	
42	–	2¾x3¾	ROLL	–	POLAROID	THEOD. PAD	–	~5.5"	ND-2	17	~1/50	–	
PX		2¼x3¼	CUT FILM	106087	RAP 107	L-1	–	480	W-12	F=120	4 μsec	5×10^6	
FX	6140-868			106080	RAP 105	L-2	–	480	W-12			1.5×10^7	
FX	6140-868			106081	RAP 108	R-1	–	480	W-12			5×10^7	
MF	0-112-13			106089	RAP 114	R-2	–	480	W-12			1×10^8	
MF	074-01	10x15cm	PLATE HOLDER	106068	WILD 148	THEOD. PAD	–	165	W-12	–	1/500	–	

DATE FILM LOADED _____ DATE CAMERA LOADED _____ DATE EXPOSED 5/25/62

REMARKS _____

WB 5/30/62 7/24/62

FORM E-40

EDGERTON, GERMESHAUSEN & GRIER, INC.

STATION NO. D

STATION TYPE Bx CONTAINER

DISTANCE GZ 32,871.3'

DISTANCE OBJECT 34,078.9'

PHOTO PLAN

BRG 237° 42' 49"

EVENT TANANA

GZ STA. GZ-10

DATE 5/25/62

POSTED

	STATION	GZ	DIFF.	TILT
N	187,941.8	182,590.0	5,351.8	GZ 0°00'
E	698,880.2	690,410.0	8,470.2	OBJ 15°17'52"
Z	~15'	9030'	9015'	

CAMERA NO.	CAMERA NOM SPD.	CAMERA BACK POS.	LENS FOC. MM	LENS S/N	LENS FILTER	FIELD TARGET H/V	AIMING OBJECT	AIMING H	AIMING V	POWER VOLTS	POWER SHUT RHEO.	POWER TIME ON/OFF	MARKER TYPE	MARKER S/N	DELAY	FILM	PURPOSE	REMARKS
DFX 11	26,000	L-3	76	C-10563	W-12	4.66 3.91	BURST	26°R	15°20'	90V DC	4.1 μsec	-2sec +6msec	MAG TAPE	M 2969	–	FX	EARLY FB	
PSAB 6	3250	R-1	105	6964236	W-12	8.11 5.64				110V DC	36°	-2sec +4sec	200	31	–	MF	FB	
PSAB 5	3250	R-2	50	66818	W-12	17.04 11.86				110V DC	9°	-4sec +2sec	200	29	–	DXN	FB	
PS10B 2	720	R-3	135	578283	W-12	14.41 7.40				110V DC	15°	-2sec +4sec	200	31	–	MF	FB	
M-43	100	L-4	75	BS1879	W-12	11.22 8.32				110V DC	60°	-5sec +25sec	200	31	–	MF	LATE FB	
GAL. 3904	–	THEOD. PAD	168	8904	W-12	30.43 20.28		23°R	7°30'	B.B.	1/400	–	–	–	–	MF	P.O.B.	
RAP. 117	–	C-1	480	806411	W-12	3.54 3.54		27°R	15°20'	120AC 28DC	4 μsec	–	–	–	50.8 μsec	PX	FB	
RAP. 102	–	C-2	480	806422	W-12	3.54 3.54				120AC 28DC	4 μsec	–	–	–	93.1 μsec	FX	FB	
RAP 113	–	C-3	480	806416	W-12	3.51 3.51				120AC 28DC	4 μsec	–	–	–	255.2 μsec	FX	FB	
RAP 111	–	C-4	480	806426	W-12	3.54 3.54				120AC 28DC	4 μsec	–	–	–	491.8 μsec	MF	FB	
BLANK	–	THEOD. PAD	~5.5°	–	ND-2		BURST	–	0°00'	MANUAL	~1/50	~4	–	–	–	42	P.O.B.	
GAL. 3903	–	THEOD. PAD	168	162232	W-12	30.43 20.28	BURST	23°R	7°00'	BB	1/400	–	–	–	–	MF	P.O.B.	

REMARKS ① AIMING ANGLE OF THEODOLITE IS 23°00' TO RIGHT OF SIGHTING POLE

② AIMING ANGLE OF CAMERAS IS 26°00' TO RIGHT OF SIGHTING POLE

③ RAPATRONIC TIMES OF EXPOSURE TO BE INCREASED BY 2 μSEC ½ COIL DELAY

④ AIMING ANGLE OF RAPATRONICS IS 27°00' TO RIGHT OF SIGHTING POLE

WB 5/20/62 7/24/62

FORM E60 A

EDGERTON, GERMESHAUSEN & GRIER, INC.

PHOTO LOADING CHART

STATION D EVENT TANANA DATE 5/25/62

FILM					CAMERA			LENS		EXPOSURE			REMARKS
TYPE	EMULS. NO.	SIZE	HOLDER	PERF. NO.	NO.	RACK POS.	NOM. SPD.	FOC. M&I	FILTER	APER.	SHUTTER SPEED	W/M²	
FX	5240725	35/33 7/8"	CASSETTE	106071	DFX 11	L-3	26,000	76	W-12	F=100	4.1 μsec	10^7	
MF	0-112-16	35/1000	MAG.	106047	PS4B 6	R-1	3250	105	W-12	2.8	36°	2.8×10^4	
DXN	5222-221	35/1000	MAG.	106052	PS4B 5	R-2	3250	50	W-12	16	9°	2.8×10^4	
MF	0-112-18	70/400	MAG.	106055	PS10B 2	R-3	720	135	W-12	4	15°	2.8×10^4	
MF	0-112-14	35/200	MAG.	106060	M-43	L-4	100	75	W-12	2.8	60°	250	
MF	074-01	10x15cm	PLATE HOLDER	106088	GALILEO 8904	THEOD. PAD	-	168	W-12	-	1/400	-	
PX		2¼" x 3¼"	CUT FILM	106086	RAP 117	C-1	-	480	W-12	F=120	4 μsec	5×10^6	
FX	6140868	↓	↓	106077	RAP 102	C-2	-	480	W-12	↓	↓	1.5×10^7	
FX	6140868	↓	↓	106078	RAP 113	C-3	-	480	W-12	↓	↓	5×10^7	
MF	0-112-13	↓	↓	106083	RAP 111	C-4	-	480	W-12	↓	↓	1×10^8	
42	-	2¾" x 3¾"	ROLL	-	POLAROID	THEOD. PAD.	-	~5.5"	ND-2	17	~1/50	-	
MF	074-01	10x15cm	PLATE HOLDER	106067	GALILEO 8905	THEOD. PAD	-	168	W-12	-	1/400	-	

DATE FILM LOADED _____ DATE CAMERA LOADED _____ DATE EXPOSED 5/25/62

REMARKS _____

WB 5/20/62 7/24/62

FORM E-40

EDGERTON, GERMESHAUSEN & GRIER, INC.

STATION NO. 298

STATION TYPE C/30

DISTANCE GZ

DISTANCE OBJECT 63,031'

PHOTO PLAN

BRG

STATION	GZ	DIFF.	TILT
N	182,590.0		GZ 0°00'
E	690,410.0		OBJ 0°00'
Z	9030'		

EVENT TANANA

GZ STA. GZ-10

DATE 5/25/62

POSTED

CAMERA NO.	CAMERA NOM SPD.	CAMERA RACK POS.	LENS FOC. MM	LENS S/N	LENS FILTER	FIELD TARGET H/V	AIMING OBJECT	AIMING H	AIMING V	POWER VOLTS	POWER SHUT RHEO.	POWER TIME ON/OFF	MARKER TYPE	MARKER S/N	DELAY	FILM	PURPOSE	REMARKS
PS4B 9	3250	L-2	150	696 2349	W-12	10°06' 6°38'	BURST	PERP. TO E OF A/S	0°00'	110V DC	36°	-3 sec +3 sec	200		—	MF	FB	
WFB 2	2000	R-2	101	A88344	W-12	12°46' 9°24'				110V DC	67%	-4 sec +3 sec	200		—	MF	FB	
FD401 3	1500	L-1	75	B1724	W-12	6°52' 4°35'				28V DC	60%	-4 sec +6 sec	200		—	MF	FB	
M-42	100	R-1	75	BS1984	W-12	18°42' 13°55'				110V DC	30°	-5 sec +25 sec	200		—	MF	LATE FB	

REMARKS CAMERA POSITIONS L. TO R. TOP TO BOTTOM, VIEWED FROM BEHIND RACK

NB 5/20/62 7/24/62

FORM E60 A

EDGERTON, GERMESHAUSEN & GRIER, INC.

PHOTO LOADING CHART

STATION 278 C130 EVENT TANANA DATE 5/25/62

FILM					CAMERA			LENS		EXPOSURE			REMARKS
TYPE	EMULS. NO.	SIZE	HOLDER	PERF. NO.	NO.	RACK POS.	NOML SPD.	FOC. MM	FILTER	APER	SHUTTER R/SEC.	W/M²	
MF	0-112-16	35/1000	MAG	106049	PSAD 4	L-2	3250	150	W-12	2.8	36°	2.8×10^{-1}	
MF	0-112-14	35/400	MAG	106057	WFB 2	R-2	2000	101	W-12	11	67%	2.8×10^{-1}	
MF	0-112-13	16/400	MAG	106064	FD401 3	L-1	1500	75	W-12	5.6	60%	2.8×10^{-1}	
MF	0-112-14	35/200	MAG	106062	M-42	R-1	100	75	W-12	2.8	30°	500	

DATE FILM LOADED _____ DATE CAMERA LOADED _____ DATE EXPOSED 5/25/62

REMARKS _____

5/20/62 7/24/62

FORM E-40

EDGERTON, GERMESHAUSEN & GRIER, INC.

STATION NO. 299

STATION TYPE C 130

DISTANCE GZ. _____

DISTANCE OBJECT 65,294'

PHOTO PLAN

BRG _____

STATION	GZ	DIFF.	TILT
N _____	182,590.0	_____	GZ 0° 00'
E _____	690,410.0	_____	OBJ 0° 00'
Z _____	9030'	_____	

EVENT TANANA

GZ STA. GZ-10

DATE 5/25/62

POSTED _____

CAMERA			LENS			FIELD TARGET H/V	AIMING			POWER			MARKER		DELAY	FILM	PURPOSE	REMARKS
NO.	NOM SPD.	RACK POS.	FOC MM	S/N	FILTER		OBJECT	H	V	VOLTS	SHUT RHEO.	TIME ON/OFF	TYPE	S/N				
PS4B 10	3250	L-2	150	6881461	W-12	10°06' 6°38'	BURST	PERP. TO E OF A/C	0°00'	110V DC	36°	-3sec +3sec	200		-	MF	FB	
WFB 3	2000	R-2	101	A88342	W-12	12°46' 9°24'				110V DC	67%	-4sec +3sec	200		-	MF	FB	
FD401 2	1500	L-1	75	B1232	W-12	6°52' 4°35'				28V DC	60%	-4sec +6sec	200		-	MF	FB	
M-44	100	R-1	75	UF5725	W-12	18°42' 13°55'				110V DC	30°	-5sec +25sec	200		-	MF	LATE FB	

REMARKS CAMERA POSITIONS L. TO R. TOP TO BOTTOM, VIEWED FROM REAR OF RACK

5/20/62 7/24/62

FORM E60 A

EDGERTON, GERMESHAUSEN & GRIER, INC.

-45-

PHOTO LOADING CHART

STATION 299 C130 EVENT TANANA DATE 5/25/62

FILM					CAMERA			LENS		EXPOSURE			REMARKS
TYPE	EMULS. NO.	SIZE	HOLDER	PERF. NO.	NO.	RACK POS.	NOM SPD.	FOC. MM	FILTER	APER.	SHUTTER RHEO.	W/M²	
MF	0-112-16	35/1000	MAG	106050	PS4B 10	L-2	3250	150	W-12	2.8	36°	2.8×10^4	
MF	0-112-14	35/400	MAG	106058	WF B 3	R-2	2000	101	W-12	11	67%	2.8×10^4	
MF	0-112-13	16/400	MAG	106065	FD401 2	L-1	1500	75	W-12	5.6	60%	2.8×10^4	
MF	0-112-14	35/200	MAG	106063	M-44	R-1	100	75	W-12	2.8	30°	500	

DATE FILM LOADED _____ DATE CAMERA LOADED _____ DATE EXPOSED 5/25/62

REMARKS _____

DR 5/30/62 7/24/62

EDGERTON, GERMESHAUSEN & GRIER, INC.

FORM E-40

-46-

PHOTO PLAN

STATION NO. B-52
STATION TYPE A/C
DISTANCE GZ
DISTANCE OBJECT 31,700'

STATION	GZ	DIFF.	TILT
N	182,590.0		GZ
E	690,410.0		OBJ
Z	9030'		

BRG
EVENT TANANA
GZ STA. GZ-10
DATE 5/25/62
POSTED

CAMERA			LENS			FIELD TARGET H/V	AIMING			POWER			MARKER		DELAY	FILM	PURPOSE	REMARKS
NO.	NOM SPD.	RACK POS.	FOC. MM	S/N	FILTER		OBJECT	H	V	VOLTS	SHUT RHEO.	TIME ON/OFF	TYPE	S/N				
PS4B	2500	WELL	105	6964260	W-12	13°35' 10°03'	BURST	180° REL TO A/C	58°	60V DC		-4sec +2sec	200	36	-	MF	FB	
WF4	2500	TAIL	50	857596	W-12	10°17' 6°52'	BURST	HEAD ↓	58°	110V DC		-4sec +3sec	200	36	-	MF	FB	DID NOT RUN

REMARKS PS4B & WF-4 PHOTOGRAPHING IMAGE REFLECTED IN MIRROR
SPEED OF PS4B IS REDUCED WITH 0.3 Ω SERIES RESISTOR

NB 5/20/62 7/24/62

-42-

FORM E60 A

EDGERTON, GERMESHAUSEN & GRIER, INC.

PHOTO LOADING CHART

STATION B-52 EVENT TANANA DATE 5/25/62

FILM					CAMERA			LENS		EXPOSURE			REMARKS
TYPE	EMULS. NO.	SIZE	HOLDER	PERF. NO.	NO.	RACK POS.	NOML SPD.	FOC. MM	FILTER	APER.	SHUTTER RHEO.	W/M²	
MF	0-112-16-14	35/1000	MAG	106250	PS48 8	WELL	2500	105	W-12	4	36°	2.8×10^{1}	
MF	0-112-15-01	16/400	MAG	106251	WF4 6	TAIL	2500	50	W-12	11	67%	2.8×10^{1}	

DATE FILM LOADED _____ DATE CAMERA LOADED _____ DATE EXPOSED 5/25/62

REMARKS _____

NB 5/30/62 7/24/62

FORM E-40

EDGERTON, GERMESHAUSEN & GRIER, INC.

APPENDIX B

SURVEY DATA, GZ-10

DATE 6/2/62

SURVEY DATA

GZ STA. GZ-10 TANANA

STA.	COORDINATES			FROM PHOTO STA.			DIST. HOR.		TANGENTS		ANGLES	
	N	E	Z	ΔN	ΔE	ΔZ*	FT.	M.	ΔE/ΔN	ΔZ/DIST.	BRG	TILT
GZ-10	182,590.0	690,410.0	2,752.0	–	–	–	–	–	–	–	–	–
Dcs	187,941.8	698,880.2	4.57	5,351.8	8,470.2	2,740.6	32,871.3	10,019.3	1.58268	.27353	237°42'49"	15°17'52"
D THEOD.	187,945.8	698,875.9	4.57	5,355.8	8,465.9	2,740.6	32,882.6	10,022.7	1.58070	.27344	237°42'52"	15°17'34"
Acs	198,521.8	693,112.6	3.05	15,931.8	2,702.6	2,731.3	53,015.9	16,159.4	.16964	.16902	189°37'39"	9°35'36"
A THEOD.	198,615.3	693,129.8	3.05	16,025.3	2,719.8	2,731.1	53,318.8	16,251.8	.16972	.16805	189°37'57"	9°32'22"
MMcs	196,588.8	682,300.1	3.05	13,998.8	8,109.9	2,731.3	53,077.7	16,178.3	.57933	.16882	149°54'54"	9°34'56"
MM THEOD.	196,664.3	682,322.9	3.05	14,074.3	8,088.0	2,731.2	53,229.0	16,224.4	.57466	.16834	150°06'56"	9°33'20"

* THIS FIGURE REPRESENTS THE APPARENT ΔZ AS SEEN FROM THE CAMERA STATION OR THEODOLITE PAD, UNCORRECTED FOR CURVATURE AND REFRACTION.

BEARING ANGLES REPRESENT TRUE AZIMUTH FROM PHOTO STA. TO GROUND ZERO.

TILT ANGLES ARE MEASURED FROM THE PHOTO STA. TO SHOT CAB OR AIR ZERO.

FORM E17 NAME C.M. EDGERTON, GERMESHAUSEN & GRIER INC.

APPENDIX C

IBM PRINTOUT SHEETS

[redacted]

OPERATION DOMINIC

SHOT	STATION	CAMERA	FILM
TANANA	A	PS481	106046

FRAME	DIA(M)	TIME(MS)	LN(TIME)	PHI	YIELD(KT)
+.	+12.44	+.00	-5.74	+124.08	+333.32
+1.	+45.43	+.32	-1.13	+71.52	+21.20
+2.	+54.98	+.64	-.44	+65.72	+13.89
+3.	+60.48	+.95	-.04	+61.51	+9.97
+4.	+65.40	+1.27	+.24	+59.30	+8.31
+5.	+69.16	+1.59	+.46	+57.37	+7.04
+6.	+72.92	+1.91	+.64	+56.24	+6.37
+7.	+76.68	+2.23	+.80	+55.61	+6.02
+8.	+79.58	+2.55	+.93	+54.71	+5.55
+9.	+81.89	+2.86	+1.05	+53.72	+5.06
+10.	+83.63	+3.18	+1.15	+52.59	+4.56
+11.	+85.08	+3.50	+1.25	+51.50	+4.10
+12.	+87.10	+3.82	+1.34	+50.93	+3.88
+13.	+88.26	+4.14	+1.42	+49.98	+3.53
+14.	+89.13	+4.46	+1.49	+49.00	+3.20
+15.	+90.29	+4.78	+1.56	+48.29	+2.97
+16.	+91.73	+5.09	+1.62	+47.81	+2.83
+17.	+93.18	+5.41	+1.68	+47.40	+2.71
+18.	+94.63	+5.73	+1.74	+47.05	+2.61
+19.	+96.65	+6.05	+1.80	+47.03	+2.60
+20.	+98.10	+6.37	+1.85	+46.76	+2.53

OPERATION DOMINIC

SHOT	STATION	CAMERA	FILM
TANANA	A	PS4B2	106051

FRAME	DIA(M)	TIME(MS)	LN(TIME)	PHI	YIELD(KT)
+.	+33.54	+.42	-.86	+47.38	+2.70
+1.	+48.07	+.92	-.07	+49.60	+3.40
+2.	+57.48	+1.42	+.35	+49.85	+3.48
+3.	+63.82	+1.93	+.65	+49.05	+3.21
+4.	+69.75	+2.43	+.89	+48.86	+3.15
+5.	+75.28	+2.94	+1.07	+48.90	+3.16
+6.	+79.37	+3.44	+1.23	+48.39	+3.00
+7.	+83.66	+3.95	+1.37	+48.29	+2.97
+8.	+86.94	+4.45	+1.49	+47.81	+2.83
+9.	+90.42	+4.96	+1.60	+47.63	+2.77
+10.	+93.28	+5.47	+1.69	+47.26	+2.67
+11.	+96.55	+5.97	+1.78	+47.22	+2.65
+12.	+99.83	+6.48	+1.86	+47.25	+2.66
+13.	+102.28	+6.99	+1.94	+46.97	+2.59
+14.	+104.74	+7.50	+2.01	+46.76	+2.53
+15.	+107.19	+8.01	+2.08	+46.62	+2.49
+16.	+109.03	+8.52	+2.14	+46.26	+2.40
+17.	+111.49	+9.03	+2.20	+46.21	+2.38
+18.	+113.12	+9.54	+2.25	+45.87	+2.30

[redacted]

OPERATION DOMINIC

SHOT	STATION	CAMERA	FILM
TANANA	MM	PS483	106053

FRAME	DIA(M)	TIME(MS)	LN(TIME)	PHI	YIELD(KT)
+.	+9.72	+.00	-4.61	+61.49	+9.96
+1.	+30.02	+.34	-1.07	+46.17	+2.37
+2.	+40.48	+.67	-.39	+47.45	+2.72
+3.	+48.48	+1.00	+.00	+48.42	+3.01
+4.	+53.77	+1.33	+.28	+47.91	+2.86
+5.	+59.31	+1.66	+.50	+48.37	+3.00
+6.	+63.98	+1.99	+.69	+48.53	+3.05
+7.	+67.18	+2.32	+.84	+47.93	+2.86
+8.	+71.00	+2.65	+.97	+48.02	+2.89
+9.	+74.08	+2.98	+1.09	+47.81	+2.83
+10.	+77.15	+3.31	+1.19	+47.75	+2.81
+11.	+79.49	+3.64	+1.29	+47.36	+2.70
+12.	+82.44	+3.97	+1.38	+47.45	+2.72
+13.	+84.90	+4.31	+1.46	+47.33	+2.69
+14.	+87.37	+4.64	+1.53	+47.28	+2.67
+15.	+90.07	+4.97	+1.60	+47.42	+2.71
+16.	+92.53	+5.30	+1.66	+47.48	+2.73
+17.	+94.75	+5.63	+1.72	+47.46	+2.72
+18.	+96.84	+5.96	+1.78	+47.41	+2.71

[redacted]

[redacted]

OPERATION DOMINIC

SHOT	STATION	CAMERA	FILM
TANANA	MM	PS4B4	106048

FRAME	DIA(M)	TIME(MS)	LN(TIME)	PHI	YIELD(KT)
+.	+28.14	+.38	-.96	+41.37	+1.37
+1.	+43.36	+.80	-.22	+47.38	+2.70
+2.	+52.26	+1.21	+.19	+48.26	+2.96
+3.	+59.15	+1.63	+.49	+48.54	+3.05
+4.	+65.18	+2.05	+.72	+48.84	+3.14
+5.	+70.06	+2.47	+.90	+48.75	+3.11
+6.	+74.37	+2.89	+1.06	+48.61	+3.07
+7.	+78.68	+3.31	+1.19	+48.72	+3.11
+8.	+81.55	+3.73	+1.31	+48.15	+2.93
+9.	+84.71	+4.14	+1.42	+47.94	+2.87
+10.	+87.58	+4.56	+1.51	+47.70	+2.79
+11.	+90.16	+4.98	+1.60	+47.42	+2.71
+12.	+92.17	+5.40	+1.68	+46.94	+2.58
+13.	+94.76	+5.82	+1.76	+46.84	+2.55
+14.	+97.63	+6.23	+1.83	+46.94	+2.58
+15.	+99.64	+6.65	+1.89	+46.68	+2.51
+16.	+102.51	+7.07	+1.95	+46.87	+2.56
+17.	+104.81	+7.48	+2.01	+46.84	+2.55

OPERATION DOMINIC

SHOT	STATION	CAMERA	FILM
TANANA	D	PS4B5	106052

FRAME	DIA(M)	TIME(MS)	LN(TIME)	PHI	YIELD(KT)
+.	+33.51	+.30	-1.20	+54.24	+5.32
+1.	+45.60	+.60	-.49	+55.59	+6.01
+2.	+49.44	+.91	-.08	+51.15	+3.97
+3.	+55.49	+1.22	+.20	+51.11	+3.95
+4.	+64.28	+1.53	+.42	+54.12	+5.26
+5.	+68.67	+1.84	+.61	+53.74	+5.07
+6.	+71.97	+2.15	+.76	+52.93	+4.70
+7.	+75.82	+2.46	+.90	+52.85	+4.67
+8.	+78.02	+2.77	+1.02	+51.87	+4.25
+9.	+80.21	+3.08	+1.12	+51.12	+3.95
+10.	+82.96	+3.39	+1.22	+50.89	+3.86
+11.	+85.71	+3.70	+1.30	+50.77	+3.82
+12.	+87.36	+4.01	+1.38	+50.11	+3.58
+13.	+88.45	+4.32	+1.46	+49.26	+3.28
+14.	+90.10	+4.62	+1.53	+48.81	+3.13
+15.	+91.20	+4.93	+1.59	+48.14	+2.93
+16.	+94.50	+5.24	+1.65	+48.68	+3.10
+17.	+95.60	+5.55	+1.71	+48.14	+2.92
+18.	+96.70	+5.86	+1.76	+47.65	+2.78
+19.	+98.34	+6.17	+1.82	+47.47	+2.73
+20.	+99.44	+6.48	+1.86	+47.07	+2.62
+21.	+101.09	+6.79	+1.91	+46.97	+2.59
+22.	+102.19	+7.10	+1.96	+46.64	+2.50

[redacted]

OPERATION DOMINIC

SHOT	STATION	CAMERA	FILM
TANANA	D	PS4B6	106047

FRAME	DIA(M)	TIME(MS)	LN(TIME)	PHI	YIELD(KT)
+.	+43.13	+.42	-.84	+60.47	+9.16
+1.	+48.58	+.86	-.14	+51.40	+4.06
+2.	+55.28	+1.30	+.26	+49.67	+3.42
+3.	+61.56	+1.74	+.55	+49.26	+3.28
+4.	+67.43	+2.18	+.78	+49.33	+3.31
+5.	+71.61	+2.62	+.96	+48.69	+3.10
+6.	+77.90	+3.06	+1.11	+49.79	+3.46
+7.	+80.83	+3.49	+1.25	+48.97	+3.19
+8.	+84.18	+3.93	+1.37	+48.65	+3.08
+9.	+87.95	+4.37	+1.47	+48.72	+3.11
+10.	+90.46	+4.81	+1.57	+48.24	+2.96
+11.	+93.81	+5.25	+1.65	+48.31	+2.98
+12.	+95.49	+5.69	+1.73	+47.62	+2.77
+13.	+98.42	+6.13	+1.81	+47.65	+2.78
+14.	+100.93	+6.57	+1.88	+47.53	+2.75
+15.	+102.61	+7.00	+1.94	+47.09	+2.62
+16.	+105.12	+7.44	+2.00	+47.08	+2.62

[redacted]

OPERATION DOMINIC

SHOT	STATION	CAMERA	FILM
TANANA	B52	PS4B8	106250

FRAME	DIA(M)	TIME(MS)	LN(TIME)	PHI	YIELD(KT)
+.	+20.58	+.10	-2.28	+51.40	+4.06
+1.	+39.30	+.47	-.73	+52.82	+4.66
+2.	+48.19	+.85	-.15	+51.34	+4.04
+3.	+55.21	+1.22	+.20	+50.83	+3.84
+4.	+60.12	+1.60	+.47	+49.75	+3.45
+5.	+65.03	+1.98	+.68	+49.47	+3.35
+6.	+69.24	+2.35	+.85	+49.14	+3.24
+7.	+72.99	+2.73	+1.00	+48.82	+3.14
+8.	+76.26	+3.10	+1.13	+48.45	+3.02
+9.	+79.54	+3.48	+1.24	+48.27	+2.97
+10.	+83.52	+3.86	+1.35	+48.65	+3.08
+11.	+86.09	+4.23	+1.44	+48.32	+2.98
+12.	+88.66	+4.61	+1.52	+48.10	+2.91
+13.	+90.53	+4.98	+1.60	+47.60	+2.76
+14.	+93.11	+5.36	+1.67	+47.55	+2.75
+15.	+95.92	+5.74	+1.74	+47.67	+2.79
+16.	+98.02	+6.11	+1.81	+47.50	+2.74
+17.	+99.89	+6.49	+1.87	+47.27	+2.67
+18.	+101.30	+6.86	+1.92	+46.86	+2.56

APPENDIX D

DIAMETER MEASUREMENTS

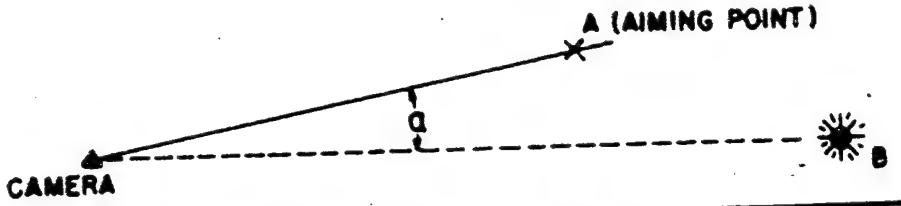
AND

CAMERA DATA CALCULATION SHEETS

[redacted]

CAMERA DATA & CALCULATIONS

FILM NO. 106 046	STATION NO. A	TEST TANANA	CALCULATED BY: BJC
CAMERA NO. PS4B-1	EQ. AP.		DATE: 7/19/62



HORIZONTAL PROJECTION

A. $R^{o}_{A} = CB_h \cos\alpha \cos\beta + (H_B - H_C) \sin\beta$

α = 0° 17' 43"	β = 10° 26' 02"	H_B = 2,752.0 m.
$\cos\alpha$ = 0.99999	$\cos\beta$ = 0.98346	H_C = 3.05 m.
CB_h = 16,159.43	$\sin\beta$ = 0.18110	ΔH = 2,731.3 m. *
$CB_h \cos\alpha \cos\beta$ = 15,891.99	$\Delta H \sin\beta$ = 494.64	R^{o}_{A} = 16,389.92 m.

B. FOCAL LENGTH 149.60 mm.

* THIS FIGURE REPRESENTS APPARENT ΔH AS SEEN FROM A SITE, UNCORRECTED FOR CURVATURE & REFRACTION.

C. MAGNIFICATION FACTOR (meters/in.)

48.08 ~ 57.88 m/in.

D. ZERO TIME CORRECTION + 0.00 msec.

[redacted]

[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. 106046

FLEXOWRITER

Fr. No.	Mag.	D_1	D_2	D_3	D_{avg} (m)	D_{avg} (m) xxx.xx	t (ms)
0000	48.08	0021	0022				
0001		0078	0079				
0002		0094	0096				
0003		0105	0104				
0004		0113	0113				
0005		0120	0119				
0006		0126	0126				
0007		0132	0133				
0008		0137	0138				
0009		0141	0142				
0010		0144	0145				
0011		0147	0147				
0012		0150	0151				
0013		0152	0153				
0014		0154	0154				
0015		0156	0156				
0016		0158	0159				
0017		0161	0161				
0018		0164	0163				
0019		0167	0167				
0020		0170	0169				

READ BY HD/rp TYPED BY

DATE 25 May 1962 DATE

REMARKS:

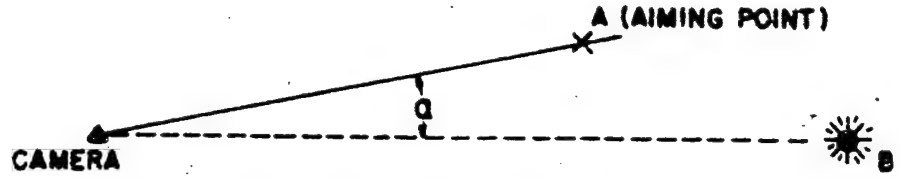
EDGERTON, GERMESHAUSEN
& GRIER, INC.

[redacted]

[redacted]

CAMERA DATA & CALCULATIONS

FILM NO. 106051	STATION NO. A	TEST TANANA	CALCULATED BY: BJC
CAMERA NO. PS4B-2	EQ. AP.		DATE: 7/19/62



HORIZONTAL PROJECTION

A. $R^{0}/_{A} = CB_h \cos\alpha \cos\beta + (H_B - H_C) \sin\beta$

α = 0° 10' 03"	β = 10° 01' 39"	H_B = 2,752.0
$\cos\alpha$ = 1.0000	$\cos\beta$ = 0.98473	H_C = 3.05 m.
CB_h = 16,159.43 m.	$\sin\beta$ = 0.17412	ΔH = 2,731.3 m. *
$CB_h \cos\alpha \cos\beta$ = 15,912.68	$\Delta H \sin\beta$ = 475.57	$R^{0}/_{A}$ = 16,391.23 m.

B. FOCAL LENGTH 352.10 mm.

* THIS FIGURE REPRESENTS APPARENT ΔH AS SEEN FROM A SITE, UNCORRECTED FOR CURVATURE & REFRACTION.

C. MAGNIFICATION FACTOR (meters/in.)

28.90 ~ 40.92 m/in

D. ZERO TIME CORRECTION +0.42 msec.

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[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. 106051 (A)

Fr. No.	Mag.	D_1	D_2	D_3	D_{avg} (m)	D_{avg} (m) xxx.xx FLEXOWRITER	t (ms)
0000	28.90	0082	0082				
0001		0118	0117				
0002		0142	0139				
0003		0156	0156				
0004		0170	0171				
0005		0184	0184				
0006		0194	0194				
0007		0204	0205				
0008		0212	0213				
0009		0220	0222				
0010		0227	0229				
0011		0236	0236				
0012		0244	0244				
0013		0251	0249				
0014		0256	0256				
0015		0261	0263				
0016		0266	0267				
0017		0272	0273				
0018		0276	0277				

READ BY HD/rl TYPED BY

DATE 26 May 1962 DATE

REMARKS: Hauser #5779

EDGERTON, GERMESHAUSEN
& GRIER, INC.

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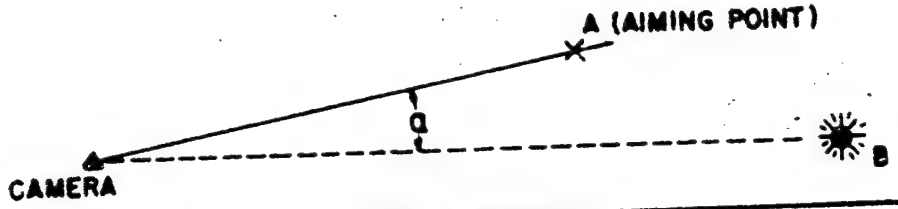
[redacted]

CAMERA DATA & CALCULATIONS

FILM NO. 106053	STATION NO. MM	TEST TANANA	CALCULATED BY: BC
CAMERA NO. PS4B-3	EQ. AP.		DATE: 7/19/62



HORIZONTAL PROJECTION

A. $R^{0}/_{A} = CB_h \cos\alpha \cos\beta + (H_B - H_C) \sin\beta$

α = 0° 21' 19"	β = 10° 27' 01"	H_B = 2,752.0 m.
cos α = 0.99998	cos β = 0.98341	H_C = 3.05 m.
CB_h = 16,178.28 m.	sin β = 0.18138	ΔH = 2,731.3 m. *
$CB_h \cos\alpha \cos\beta$ = 15,909.56	$\Delta H \sin\beta$ = 495.40	$R^{0}/_{A}$ = 16,408.30 m.

B. FOCAL LENGTH 352.20 mm.

* THIS FIGURE REPRESENTS APPARENT ΔH AS SEEN FROM MM SITE, UNCORRECTED FOR CURVATURE & REFRACTION.

C. MAGNIFICATION FACTOR (meters/in.)

48.08 ~ 24.61 m./in.

D. ZERO TIME CORRECTION + 0.00 m sec.

[redacted]

[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. 106053

Fr. No.	Mag.	D_1	D_2	D_3	D_{avg} (m)	FLEXOWRITER D_{avg} (m) xxx.xx	t (ms)
0000	48.08	0038	0041				
0001		0122	0122				
0002		0162	0167				
0003		0198	0196				
0004		0216	0221				
0005		0240	0242				
0006		0259	0261				
0007		0273	0273				
0008		0288	0289				
0009		0299	0303				
0010		0313	0314				
0011		0321	0325				
0012		0335	0335				
0013		0344	0346				
0014		0353	0357				
0015		0366	0366				
0016		0377	0375				
0017		0386	0384				
0018		0393	0394				

READ BY RP/rl TYPED BY

DATE 25 May 1962 DATE

REMARKS: Hauser #5779

EDGERTON, GERMESHAUSEN
& GRIER, INC.

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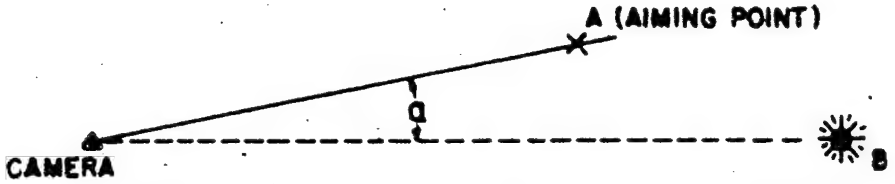
CAMERA DATA & CALCULATIONS

FILM NO. 106048	STATION NO. MM	TEST TANANA	CALCULATED BY: BJC
CAMERA NO. PS4B-4	EQ. AP.		DATE: 9/19/62



HORIZONTAL PROJECTION

A. $R^{0}/_{A} = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

α = 0° 29' 27"	β = 10° 31' 06"	H_B = 2,752.0 m.
cos α = 0.99996	cos β = 0.98319	H_C = 3.05 m.
CB_h = 16,178.28 m.	sin β = 0.18255	ΔH = 2,731.3 m. *
$CB_h \cos \alpha \cos \beta$ = 15,905.68	$\Delta H \sin \beta$ = 498.60	$R^{0}/_{A}$ = 16,407.73 m

B. FOCAL LENGTH 149.90 m.m.

* THIS FIGURE REPRESENTS APPARENT ΔH AS SEEN FROM MM SITE, UNCORRECTED FOR CURVATURE & REFRACTION.

C. MAGNIFICATION FACTOR (meters/in.)

48.41 ~ 57.43 m./in.

D. ZERO TIME CORRECTION + 0.38 msec.

[redacted]

[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. 106048 (MM)

FLEXOWRITER

Fr. No.	Mag.	D_1	D_2	D_3	D_{avg} (m)	D_{avg} (m) xxx.xx	t (ms)
0000	48.41	0049	0049				
0001		0075	0076				
0002		0091	0091				
0003		0103	0103				
0004		0113	0114				
0005		0122	0122				
0006		0129	0130				
0007		0137	0137				
0008		0142	0142				
0009		0147	0148				
0010		0152	0153				
0011		0157	0157				
0012		0160	0161				
0013		0165	0165				
0014		0170	0170				
0015		0173	0174				
0016		0178	0179				
0017		0182	0183				

READ BY RL/hd TYPED BY

DATE 25 May 1962 DATE

REMARKS: (Hauser No. 5171)

EDGERTON, GERMESHAUSEN
& GRIER, INC.

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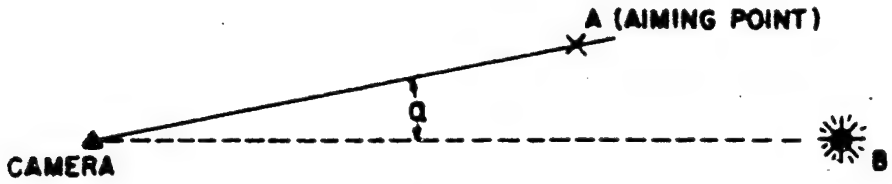
CAMERA DATA & CALCULATIONS

FILM NO. 106072	STATION NO. MM	TEST TANANA	CALCULATED BY: BJC
CAMERA NO. DFX-13	EQ. AP.		DATE: 7/19/62



HORIZONTAL PROJECTION

A. $R^{o}_{A} = CB_h \cos\alpha \cos\beta + (H_B - H_C) \sin\beta$

α = 0° 00' 00"	β = 9° 38' 40"	H_B = 9030'
$\cos\alpha$ = 1.00000	$\cos\beta$ = .98587	H_C = 10'
CB_h = 16,178.3 m.	$\sin\beta$ = .16753	ΔH = 2731.3 m. *
$CB_h \cos\alpha \cos\beta$ = 15,949.7 m.	$\Delta H \sin\beta$ = 457.6	R^{o}_{A} = 16,407.0 m

B. FOCAL LENGTH 250.22 mm.

* THIS FIGURE REPRESENTS THE APPARENT ΔH AS SEEN FROM MM SITE, UNCORRECTED FOR CURVATURE AND REFRACTION.

C. MAGNIFICATION FACTOR (meters/in.)

28.90 ~ 57.629 m/in

D. ZERO TIME CORRECTION +0.021 msec

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[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. 106072

MM Site

FLEXOWRITER

Fr. No.	Mag.	D_1	D_2	D_{avg} (in.)	D_{avg} (m)	D_{avg} (m) xxx.xx	t (ms)
0000	28.90	0021	0024	.225	12.97		0.021
0002		0038	0040	.390	22.48		0.105
0004		0047	0048	.475	27.37		0.188
0006		0051	0054	.525	30.26		0.272
0008		0058	0059	.535	33.71		0.355
0010		0062	0062	.620	35.73		0.439
0012		0066	0066	.660	38.04		0.523
0014		0069	0069	.690	39.76		0.606
0016		0073	0074	.735	42.36		0.690
0018		0076	0077	.765	44.09		0.773
0020		0079	0079	.790	45.53		0.857
0022		0082	0083	.825	47.54		0.941
0024		0085	0087	.860	49.56		1.024
0026		0088	0089	.885	51.00		1.108
0028		0091	0091	.910	52.44		1.191
0030		0093	0094	.935	53.88		1.275
0032		0096	0097	.965	55.61		1.359
0034		0101	0100	1.005	57.92		1.442
0036		0105	0104	1.045	60.22		1.526
0038		0109	0108	1.085	62.53		1.609
0040		0112	0111	1.115	64.26		1.693
0042		0115	0115	1.150	66.27		1.777
0044		0117	0117	1.170	67.43		1.860
0046		0117	0118	1.175	67.71		1.944
0048		0118	0119	1.185	68.29		2.028
0050		0119	0120	1.195	68.87		2.111
0052		0120	0121	1.205	69.44		2.195
0054		0121	0122	1.215	70.02		2.278
0056		0123	0124	1.235	71.17		2.362
0058		0124	0125	1.245	71.75		2.446
0060		0125	0125	1.250	72.04		2.529
0062		0126	0126	1.260	72.61		2.613

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DATE 25 May 1962 DATE

REMARKS: Hauser #5779

EDGERTON, GERMESHAUSEN
& GRIER, INC.

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DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. 106072

Fr. No.	Mag.	D_1	D_2	D_{avg} (in.)	D_{avg} (m)	FLEXOWRITER D_{avg} (m) xxx.xx	t (ms)
0064	28.90	0127	0127	1.270	73.19		2.696
0066		0128	0128	1.280	73.77		2.780
0068		0130	0129	1.295	74.63		2.864
0070		0131	0131	1.310	75.49		2.947
0072		0132	0132	1.320	76.07		3.031
0074		0133	0133	1.330	76.65		3.115
0076		0134	0133	1.335	76.93		3.198
0078		0135	0135	1.350	77.80		3.282
0080		0136	0135	1.355	78.09		3.365
0082		0137	0136	1.365	78.66		3.449
0084		0138	0138	1.380	79.53		3.533
0086		0139	0139	1.390	80.10		3.616
0088		0140	0140	1.400	80.68		3.700
0090		0141	0141	1.410	81.26		3.783
0092		0142	0142	1.420	81.83		3.867
0094		0143	0144	1.435	82.70		3.951
0096		0144	0146	1.450	83.56		4.034
0098		0145	0146	1.455	83.85		4.118
0100		0146	0147	1.465	84.43		4.202
0102		0147	0149	1.480	85.29		4.285
0104		0148	0149	1.485	85.58		4.369
0106		0149	0150	1.495	86.16		4.452

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DATE 25 May 1962 DATE

REMARKS: Hauser #5779

EDGERTON, GERMESHAUSEN
& GRIER, INC.

[redacted]

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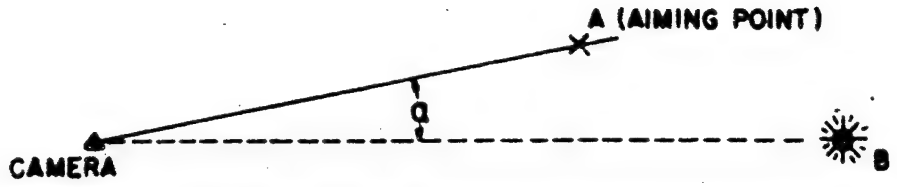
CAMERA DATA & CALCULATIONS

FILM NO. 106052	STATION NO. D	TEST TANANA	CALCULATED BY: BJC
CAMERA NO. PS48-5	EQ. AP.		DATE: 7/19/62



HORIZONTAL PROJECTION

A. $R^{o}/_{A} = CB_h \cos\alpha \cos\beta + (H_B - H_C) \sin\beta$

α = 1° 03' 53"	β = 15° 20' 11"	H_B = 2,752.0 m.
cos α = 0.99983	cos β = 0.96439	H_C = 4.57 m.
CB_h = 10,019.28 m.	sin β = 0.26448	ΔH = 2,740.6 m. *
$CB_h \cos\alpha \cos\beta$ = 9,660.89	$\Delta H \sin\beta$ = 724.83	$R^{o}/_{A}$ = 10,387.58 m.

B. FOCAL LENGTH 49.60 mm.

* THIS FIGURE REPRESENTS APPARENT ΔH AS SEEN FROM D SITE, UNCORRECTED FOR CURVATURE AND REFRACTION.

C. MAGNIFICATION FACTOR (meters/in.)

48.41 ~ 109.88 m/in.

D. ZERO TIME CORRECTION + 0.30 msec

[redacted]

[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. 106052

FLEXOWRITER

Fr. No.	Mag.	D_1	D_2	D_3	D_{avg} (m)	D_{avg} (m) xxx.xx	t (ms)
0000	48.41	0031	0030				
0001		0042	0041				
0002		0045	0045				
0003		0051	0050				
0004		0059	0058				
0005		0063	0062				
0006		0066	0065				
0007		0069	0069				
0008		0071	0071				
0009		0073	0073				
0010		0076	0075				
0011		0078	0078				
0012		0079	0080				
0013		0080	0081				
0014		0082	0082				
0015		0083	0083				
0016		0086	0086				
0017		0087	0087				
0018		0088	0088				
0019		0090	0089				
0020		0091	0090				
0021		0092	0092				
0022		0093	0093				

READ BY RL/hd TYPED BY

DATE 26 May 1962 DATE

REMARKS:

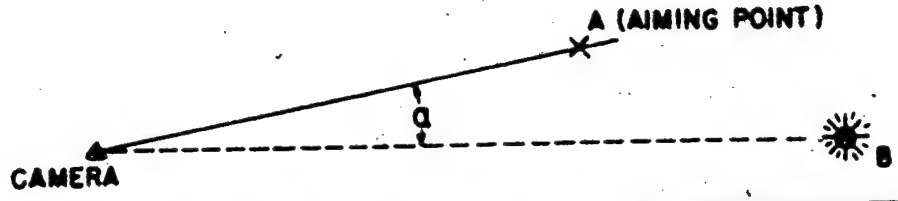
EDGERTON, GERMESHAUSEN
& GRIER, INC.

[redacted]

[redacted]

CAMERA DATA & CALCULATIONS

FILM NO. 106047	STATION NO. D	TEST TANANA	CALCULATED BY: BJC
CAMERA NO. PS4B-6	EQ. AP.		DATE: 7/19/62



A. $R^{\circ}_{A} = CB_h \cos\alpha \cos\beta + (H_B - H_C) \sin\beta$

α = 1° 39' 56"	β = 15° 52' 24"	H_B = 2,752.0 m
$\cos\alpha$ = 0.99958	$\cos\beta$ = 0.96187	H_C = 4.57 m.
CB_h = 10,019.28 m.	$\sin\beta$ = 0.27351	ΔH = 2,740.6 m. *
$CB_h \cos\alpha \cos\beta$ = 9,633.24	$\Delta H \sin\beta$ = 749.58	R°_{A} = 10,384.72 m

B. FOCAL LENGTH 108.40 mm.

* THIS FIGURE REPRESENTS APPARENT ΔH AS SEEN FROM D SITE, UNCORRECTED FOR CURVATURE & REFRACTION.

C. MAGNIFICATION FACTOR (meters/in.)

29.05 ~ 84.42 m./in.

D. ZERO TIME CORRECTION + 0.42 msec

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DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. 106047

Fr. No.	Mag.	D_1	D_2	D_3	D_{avg} (m)	FLEXOWRITER D_{avg} (m) xxx.xx	t (ms)
0000	29.05	0052	0051				
0001		0057	0059				
0002		0066	0066				
0003		0074	0073				
0004		0081	0080				
0005		0086	0085				
0006		0094	0092				
0007		0097	0096				
0008		0101	0100				
0009		0105	0105				
0010		0108	0108				
0011		0112	0112				
0012		0114	0114				
0013		0117	0118				
0014		0120	0121				
0015		0122	0123				
0016		0125	0126				

READ BY RL/hd TYPED BY

DATE 25 May 1962 DATE

REMARKS: (Hauser No. 5171)

EDGERTON, GERMESHAUSEN
& GRIER, INC.

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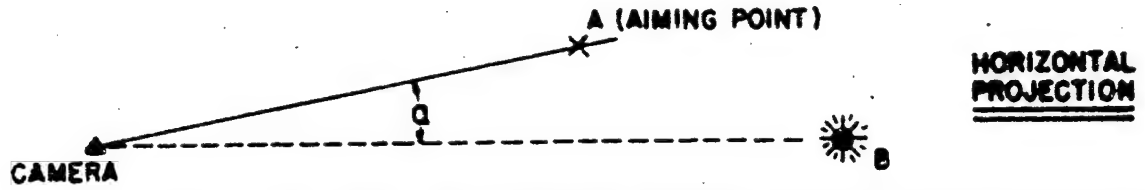
CAMERA DATA & CALCULATIONS

FILM NO. 106071	STATION NO. D	TEST TANANA	CALCULATED BY: BJC
CAMERA NO. DFX-11	EQ. AP.		DATE: 7/21/62



A. $R^{o}/_{A} = CB_h \cos\alpha \cos\beta + (H_B - H_C) \sin\beta$

α = 0° 00' 00"	β = 15° 20' 11"	H_B = 2,752.0 m.
$\cos\alpha$ = 1.00000	$\cos\beta$ = 0.96439	H_C = 4.57 m.
CB_h = 10,019.28 m.	$\sin\beta$ = 0.26448	ΔH = 2,740.6 m. *
$CB_h \cos\alpha \cos\beta$ = 9,662.49	$\Delta H \sin\beta$ = 724.83	$R^{o}/_{A}$ = 10,384.9 m.

B. FOCAL LENGTH 76.25 mm.

* THIS FIGURE REPRESENTS APPARENT ΔH AS SEEN FROM D SITE, UNCORRECTED FOR CURVATURE & REFRACTION.

C. MAGNIFICATION FACTOR (meters/in.)

48.735 ~ 70.983 m/in.

D. ZERO TIME CORRECTION + 0.023 msec.

[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. DFX 106071

Fr. No.	Mag.	D_1	D_2	D_3	D_{avg} (m)	FLEXOWRITER D_{avg} (m) xxx.xx	t (ms)
0000	48.735	0038	0037		0.375	26.62	0.023
0001		0045	0046		0.455	32.30	0.069
0002		0047	0049		0.480	34.07	0.115
0003		0050	0051		0.505	35.85	0.161
0004		0052	0055		0.535	37.98	0.207
0005		0055	0056		0.555	39.40	0.253
0006		0060	0060		0.600	42.59	0.299
0008		0062	0062		0.620	44.01	0.391
0010		0064	0065		0.645	45.78	0.483
0012		0066	0067		0.665	47.20	0.575
0014		0069	0069		0.690	48.98	0.666
0016		0070	0071		0.705	50.04	0.758
0018		0072	0072		0.720	51.11	0.850
0020		0074	0076		0.750	53.24	0.942
0022		0077	0079		0.780	55.37	1.034
0024		0081	0083		0.820	58.21	1.126
0026		0083	0085		0.840	59.63	1.218
0028		0085	0087		0.860	61.05	1.310
0030		0087	0089		0.880	62.47	1.402
0032		0089	0090		0.895	63.53	1.494
0034		0090	0092		0.910	64.59	1.586
0036		0092	0094		0.930	66.01	1.678
0038		0093	0096		0.945	67.08	1.769
0040		0095	0096		0.955	67.79	1.861
0042		0096	0097		0.965	68.50	1.953
0044		0098	0098		0.980	69.56	2.045
0046		0099	0099		0.990	70.27	2.137
0048		0100	0101		1.005	71.34	2.229
0050		0102	0102		1.020	72.40	2.321
0052		0105	0103		1.040	73.82	2.413
0054		0106	0104		1.050	74.53	2.505
0056		0107	0105		1.060	75.24	2.597
0058		0108	0107		1.075	76.31	2.684
0060		0110	0109		1.095	77.73	2.781
0062		0111	0110		1.105	78.44	2.873

READ BY JMT/AR TYPED BY

DATE 7/20/62 DATE

REMARKS: Hauser No. 3815

EDGERTON, GERMESHAUSEN & GRIER, INC.

[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. 106071

Fr. No.	Mag.	D_1	D_2	D_3	D_{avg} (m)	FLEXOWRITER D_{avg} (m) xxx.xx	t (ms)
0064		0111	0111		1.110	78.79	2.964
0066		0113	0113		1.130	80.21	3.056
0068		0113	0114		1.135	80.57	3.148
0070		0114	0115		1.145	81.28	3.240
0072		0115	0115		1.150	81.63	3.332
0074		0116	0116		1.160	82.34	3.424
0076		0118	0117		1.175	83.41	3.516
0078		0118	0118		1.180	83.76	3.608
0080		0119	0119		1.190	84.47	3.700
0082		0121	0120		1.205	85.53	3.792
0084		0122	0121		1.215	86.24	3.884
0086		0122	0122		1.220	86.60	3.976
0088		0123	0123		1.230	87.31	4.067
0090		0124	0124		1.240	88.02	4.159
0092		0126	0125		1.255	89.08	4.251
0094		0127	0126		1.265	89.79	4.343
0096		0128	0127		1.275	90.50	4.435
0098		0129	0128		1.285	91.21	4.527
0100		0130	0130		1.300	92.28	4.619
0102		0130	0131		1.305	92.63	4.711
0104		0131	0132		1.315	93.34	4.803
0106		0132	0132		1.320	93.70	4.895
0108		0133	0133		1.330	94.41	4.987
0110		0134	0134		1.340	95.12	5.079
0112		0134	0135		1.345	95.47	5.171
0114		0135	0136		1.355	96.18	5.262
0116		0136	0137		1.365	96.89	5.354
0118		0137	0138		1.375	97.60	5.446
0120		0138	0139		1.385	98.31	5.538
0122		0139	0140		1.395	99.02	5.630
0124		0140	0141		1.405	99.73	5.722
0126		0140	0142		1.410	100.09	5.814
0128		0141	0142		1.415	100.44	5.906
0130		0142	0142		1.420	100.80	5.998

READ BY JMT/AR TYPED BY

DATE 7/20/62 DATE

REMARKS: Hauser No. 3815

EDGERTON, GERMESHAUSEN & GRIER, INC.

[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA FILM NO. 106071

Fr. No.	Mag.	D_1	D_2	D_3	D_{avg} (m)	FLEXOWRITER D_{avg} (m) xxx.xx	t (ms)
0132		0142	0143		1.425	101.15	6.090
0134		0143	0143		1.430	~~101.51~~	6.182
0136		0143	0144		1.435	~~101.86~~	6.274
0138		0143	0144		1.435	101.86	6.365
0140		0143	0144		1.435	101.86	6.457

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DATE 7/20/62 DATE

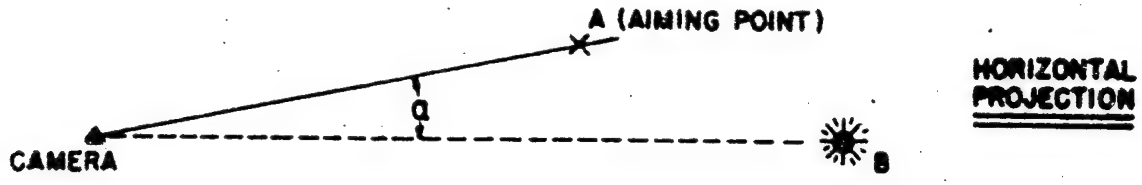
REMARKS: Hauser No. 3815

EDGERTON, GERMESHAUSEN
& GRIER, INC.

[redacted]

CAMERA DATA & CALCULATIONS

FILM NO. 106250	STATION NO. B-52	TEST TANANA	CALCULATED BY: R.
CAMERA NO. PS 4B-8	EQ. AP.		DATE: 6-2-62



A. $R^{0}_{A} = CB_h \cos\alpha \cos\beta + (H_B - H_C) \sin\beta$

α = 1°12'30"	β = 1°4'30"	H_B = 9030'
$\cos\alpha$ = 0.99978	$\cos\beta$ = 0.99982	H_C =
CB_h =	$\sin\beta$ =	ΔH =
$CB_h \cos\alpha \cos\beta$ =	$\Delta H \sin\beta$ =	R^{0}_{A} = 31687'

B. FOCAL LENGTH 108.30 mm

DME - SLANT RANGE = 31700 ± 820 FEET

C. MAGNIFICATION FACTOR (meters/in.)

48.41 ~ 46.79.

D. ZERO TIME CORRECTION ± 0.10 msec.

[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA

FILM NO. 106250 (B-52)

FR. NO.	MAG.	D_1	D_2	D_3	D_{avg} (m)	FLEXOWRITER D_{avg} (m) XXX·XX	FLEXOWRITER t (ms)
0000	48.41	0044	0044				
0001		0084	0084				
0002		0103	0103				
0003		0118	0118				
0004		0129	0128				
0005		0139	0139				
0006		0148	0148				
0007		0156	0156				
0008		0163	0163				
0009		0170	0170				
0010		0179	0178				
0011		0183	0185				
0012		0189	0190				
0013		0193	0194				
0014		0199	0199				
0015		0204	0206				
0016		0209	0210				
0017		0213	0214				
0018		0216	0217				

The fireball record on this film is oblong in shape and appears to be in good focus.

READ BY RL/hd TYPED BY

DATE 25 May 1962 DATE

REMARKS: Hauser No. 5171

FORM NO. E-62 REV. 7/62

EDGERTON, GERMESHAUSEN & GRIER, INC.

[redacted]

DIAMETER MEASUREMENTS

SHOT TANANA

FILM NO. Rapatronics

	FR. NO.	MAG.	D_1	D_2	D_3	D_{avg} (m)	FLEXOWRITER D_{avg} (m) XXX·XX	FLEXOWRITER t (ms)
A -	106085	29.05	0067	0066		0.66	19.55	0.057
	106074		0083	0084		0.83	24.63	0.107
	106075		0100	0102		1.01	29.71	0.235
	106082		0121	0118		1.19	35.26	0.529
D -	106086		0095	0099		0.97	18.06	0.053
	106077		0116	0115		1.15	21.60	0.095
	106078		0181	0183		1.82	34.18	0.257
	106083		0195	0196		1.95	36.59	0.494
M -	106087		0088	0080		0.84	24.78	0.054
	106080		0084	0082		0.83	24.53	0.101
	106081		0105	0102		1.03	30.33	0.246
	106084		0120	0122		1.21	35.69	0.525

READ BY _____ TYPED BY _____

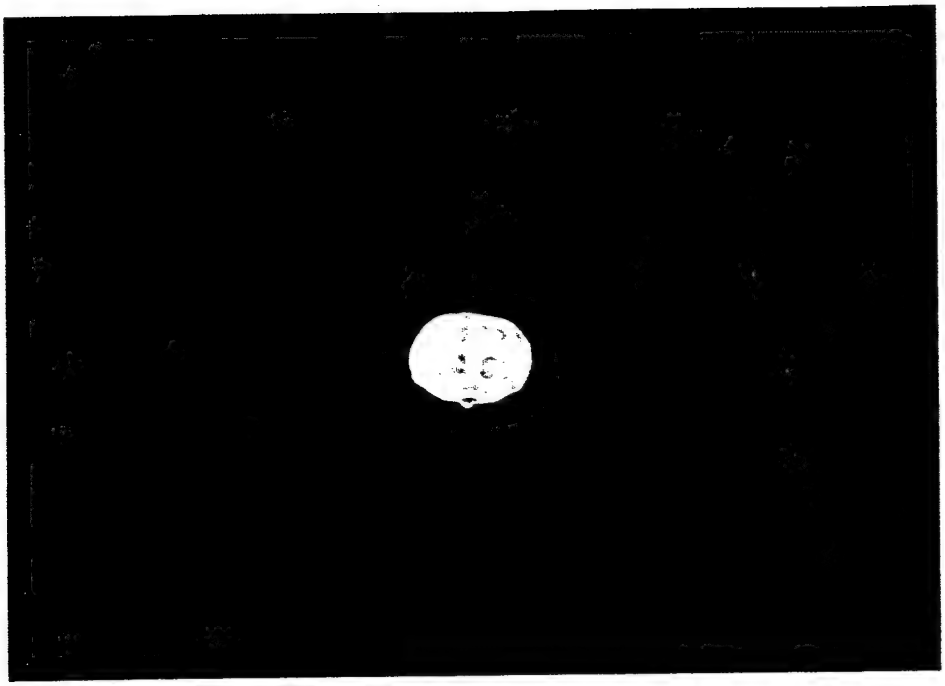
DATE _____ DATE _____

REMARKS:

[redacted]

APPENDIX E

FIREBALL PHOTOGRAPHS

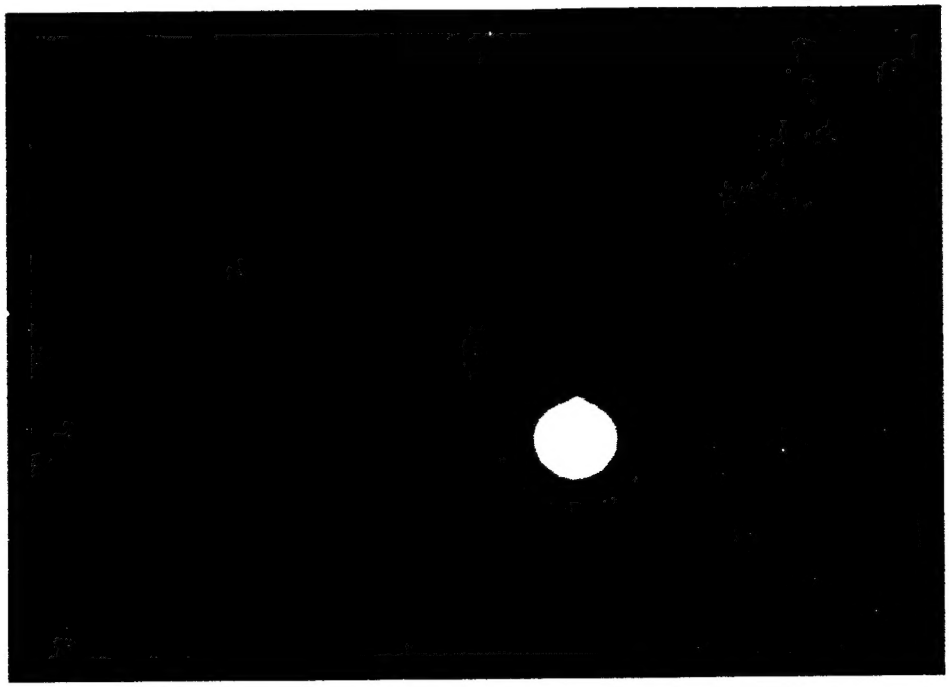


Station: D Site

Film No. 106083

Camera: Rapatronic 111

Time: 493.8 usec

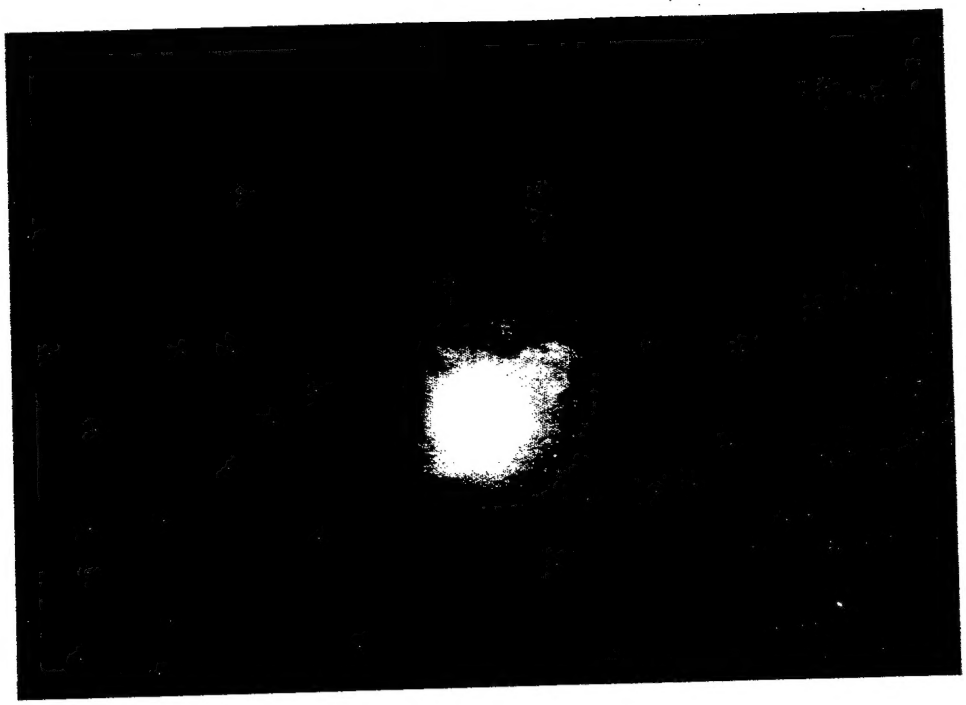


Station: MM Site

Film No. 106053

Camera: PS4B-3

Time: 5.30 msec

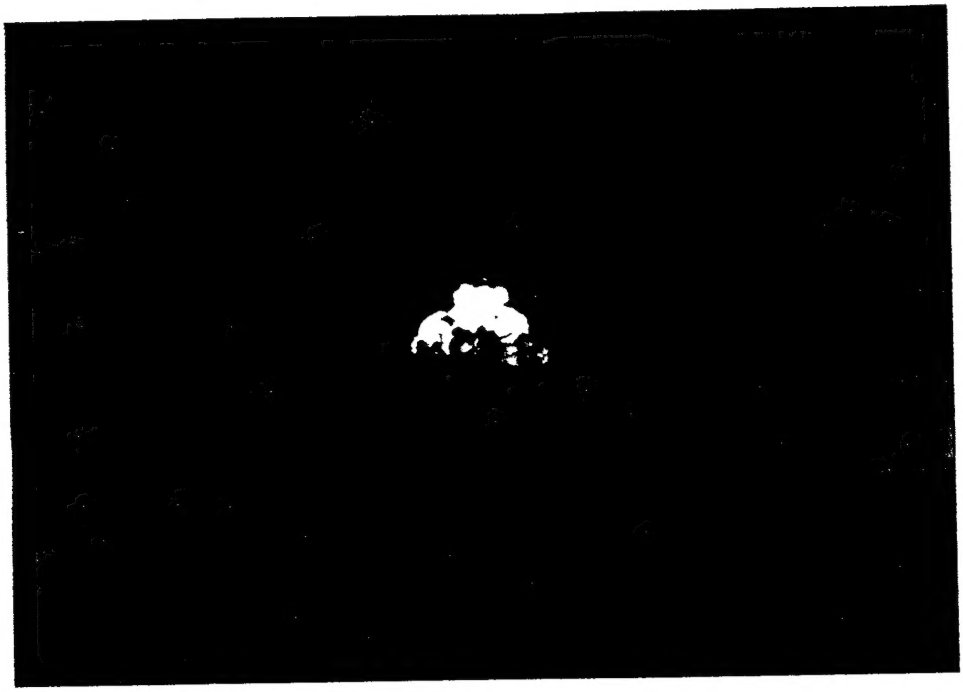


Station: A Site

Film No. 106051

Camera: PS4B-2

Time: 8.01 msec



Station: 299 (C-130 Aircraft)

Film No. 106063

Camera: M-44

Time: unknown (camera started late)

[redacted]

DISTRIBUTION

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